

# *Standards Requirements Package 3: Information Service Provider Wireless Interfaces*

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# **1. Introduction to Standards Requirements Documentation**

The Standards Requirements Packages are intended to be used in conjunction with the other architecture documents. In particular, the introductory chapters of the Standards Requirements Document provide contextual material and explanations/justifications of some of the methods used to evaluate and rate architecture flows. However, it is recognized that many people may initially only receive a given Standards Requirements Package, without the associated supporting material. To aid these individuals, we offer some generic introductory material to promote understanding of the context and approach used to create a Standards Requirements Package. Ultimately, any standards development organization pursuing an ITS-related standard should ensure that they have access to a complete set of the architecture documents as a reference source.

## **1.1. Standards Requirements Document Executive Summary**

The executive summary of the Standards Requirements Document is reproduced here, to provide a sense of the overall goals and content of the document.

The Standards Requirements Document ("SRD") collects information from the other National ITS Architecture program documents and reorganizes it in a manner intended to support the development of critical ITS standards. The key results in the SRD are a reference model for the National ITS Architecture, a rating scheme for evaluating the standardization issues associated with individual data flows that make up the architecture interfaces, and then a set of priority groupings of interfaces into standards requirements "packages". These results and the major conclusions are summarized below.

The introductory section explains the structure of the SRD and its intended usage. The strategy is that the reference model provides the overall context for a standards development organization ("SDO"). A given SDO can pull a particular package of standards requirements out of the document and then use the reference model as a quick reference to the overall architecture. More detailed needs will require going to the original source documents, such as the Logical or Physical Architectures.

The next section provides the rationale for several different ratings schemes applied to the architecture interconnects and flows. These include interoperability requirements, technology maturity assessments, stakeholder interest. All architecture interconnects were examined with respect to these measures. The stakeholder interest and interoperability requirements in particular were then used as the basis for selecting the standards requirements packages. In general, interfaces associated with mobile systems had both the greatest stakeholder interest and the most stringent interoperability requirements. Following close behind were interfaces associated with Traffic Management and Information Service Provider subsystems.

The Architecture Reference Model is provided next as a high level definition of the components that form the National ITS Architecture. It depicts the interconnectivity of the subsystems and terminators, their definitions, and suitable types of communications strategies. This reference model is an important tool for communicating the full breadth of the architecture at an abstracted level. In the SRD it is intended as a contextual reference, but, as a separate document, the reference model has received international circulation through the International Standards Organization (ISO) as a basis for documenting and comparing ITS architectures.

The "meat" of the SRD is the set of standards requirements packages. Each package is a special grouping

of standards requirements and contextual information intended to be used in a nearly standalone fashion by an SDO. Thus, packages have been selected that cover the key ITS priorities, maintain the integrity and vision of the National ITS Architecture, and also are perceived as having an interested stakeholder constituency that will help drive standardization. This is a difficult balancing act, but the following 13 packages were identified as covering the high priority standardization needs for the architecture program:

1. Dedicated Short Range Communications (DSRC, formerly “VRC”)
2. Digital Map Data Exchange and Location Referencing Formats
3. Information Service Provider Wireless Interfaces
4. Inter-Center Data Exchange for Commercial Vehicle Operations
5. Personal, Transit, and HAZMAT Maydays
6. Traffic Management Subsystem to Other Centers (except EMS)
7. Traffic Management Subsystem to Roadside Devices and Emissions Monitoring
8. Signal Priority for Transit and Emergency Vehicles
9. Emergency Management Subsystem to Other Centers
10. Information Service Provider Subsystem to Other Centers (except EMS and TMS)
11. Transit Management Subsystem Interfaces
12. Highway Rail Intersections (HRI)
13. Archived Data Management Subsystem Interfaces

These 13 areas cover much of the National ITS Architecture and represent the distillation of stakeholder interests and architecture interoperability requirements. If standardization can be achieved in the near term for all or most of these packages, then ITS will be a long ways towards achieving the original vision captured in the user service requirements.

## **1.2. Constructing a Standards Requirements Package**

The intent of creating a Standards Requirements Package is to facilitate efforts to standardize some subset of the National ITS Architecture. The “packaging” process involves abstracting and reorganizing information from other documents, primarily the Logical and Physical Architectures. We have gone through a number of iterations to try and achieve a format that is understandable and useful for SDO's; in the end, while there is not a universal consensus, we have tried to address the substance of most of the comments received.

This Standards Requirements Package has the following main components:

- General introduction to the scope and intent of this package
- Message transaction sets
- Decomposition of the interfaces
- Communications Considerations
- Constraints
- Leveled Data Item definitions

The general introduction is self-explanatory, but the other items require some explanation. We will address them one at a time:

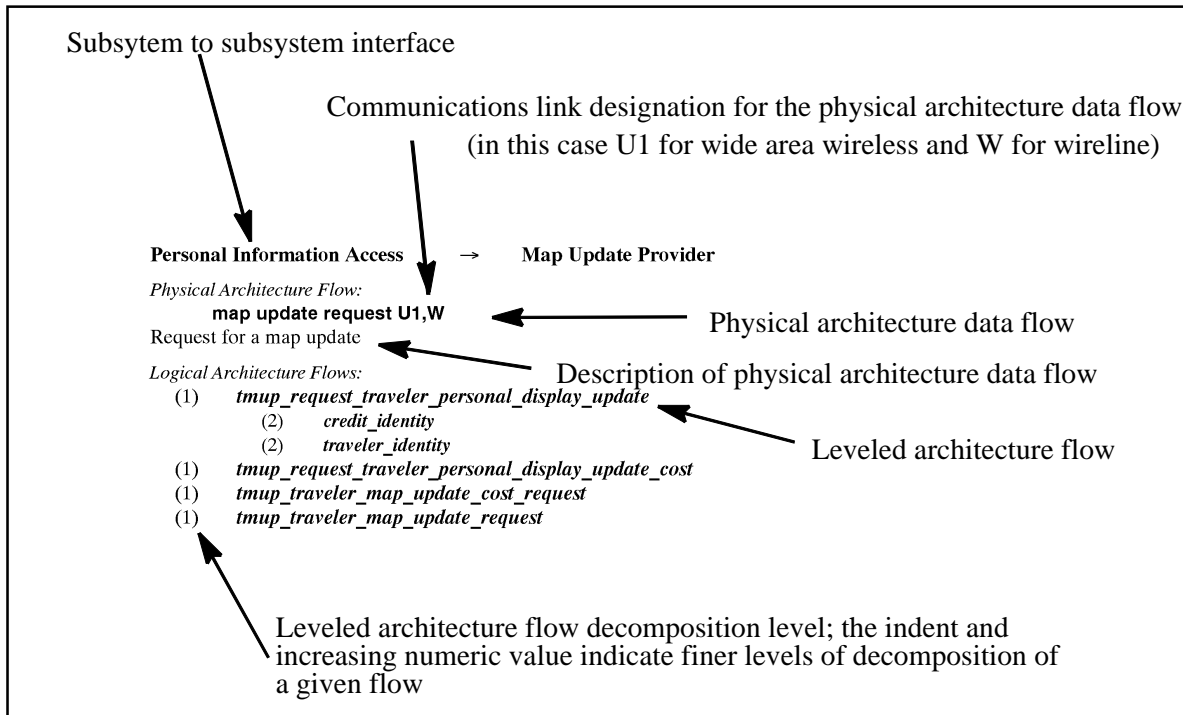
*Message Transaction Sets:* In order to accomplish a given activity, a series of messages usually have to be exchanged between two or more subsystems. These messages, as a group, constitute a message transaction set. The sequencing of the messages is shown via an ISO-style message sequence chart. Typically the physical architecture flow or highest level logical architecture data flows represent individual messages.

*Interface Decomposition:* This is the hierarchy of items that constitute an interface. It starts with the interface between two subsystems itself, which is then decomposed into physical architecture flows. Each of the physical architecture flows is then decomposed into a set of Leveled Architecture Flows. These sets of flows have been created in order to capture the essential information described by the National ITS Architecture on each Subsystem interface of interest. The Leveled Architecture Flows can be thought of as a simplified view of the logical architecture information, removing aggregation of data which does not add value to describing the essential information on the interface, and removing some of the lower level details in the existing data flows. These leveled architecture flows are traceable to flows in the logical architecture. The physical architecture data flows are labeled with the type of communications technology appropriate for that flow. Figure 1 shows an example of an interface decomposition. The leveled data items represent a simplification of the logical architecture information to focus on the essential data on each subsystem interface. They have been developed in order to provide traceability between the ITS standards being developed and the National ITS Architecture. Once a draft standard has been developed, the question that must be addressed is whether the standard addresses completely all elements of the National ITS Architecture interface. Due to the complex hierarchical nature of the Logical Architecture data flows, comparison with standards outputs is very difficult. By creating a simplified view of each interface, it is possible to more effectively trace the standards outputs to the National ITS Architecture.

*Communications Considerations* provides a discussion of the basic nature of the communications modalities that are suitable for supporting the interfaces in the particular standards requirements package. This section identifies some high level requirements, but the primary focus is to provide information that is viewed as useful to the initiation of the standardization process.

*Constraints* lists the architecture flows and any constraints placed upon them.

*Leveled Data Items:* This section provides a set of definitions for each of the leveled data elements included in the Interface Decomposition section. These definitions are simplified versions of the definitions contained in the Logical Architecture Data Dictionary, providing just the essential information to define the key elements of a subsystem interface.



**Figure 1. Example of the parts of an interface decomposition**

As a final clarification, it is useful to remind readers of the distinction between the layers in the ISO OSI communications reference model and the layers in the National ITS Architecture. For purposes of analysis and discussion, the National ITS Architecture has been portrayed as having three layers: *the transportation, the communications, and the institutional layer*. The first two are of concern here. The transportation layer contains all the functionality of the National ITS Architecture. As a consequence, any discussion of interfaces, messages, data dictionary entries, etc., is drawn from the information in the transportation layer. The communications layer describes the technology required to support the information exchange needs of the transportation layer. These National ITS Architecture layers can be roughly mapped to the ISO OSI reference model; the transportation layer is typically at or above the application layer and the communications layer is most often concerned with the lowest four layers of the ISO OSI reference model. The interested reader is directed to the Communications Analysis Document for a more substantial explanation of this relationship.

This explanation of the layers is offered here because the terminology can be confusing. Every effort has been made to clarify when the “layered model” is the National ITS Architecture and when it is the OSI reference model. In general, when the term “communications layer” is used in the Standards Requirements Document, it refers to the National ITS Architecture “layer”.

## 2. Introduction: Information Service Provider Wireless Interfaces

In the spirit of creating a seamless nationwide transportation information service, the wireless links between ISPs and their mobile clients is critical for the creation of wide spread usage and acceptance of these services. Achieving standards that allow an ATIS user to move across jurisdictions while continuing to receive services will aid the development of the larger markets necessary to attract investment in developing services.

The ISP wireless links are the wide area wireless links from ISPs to Vehicles (or Personal Information Access devices) and for 2-way channels from Vehicles (or Personal Information Access devices) to ISPs. These messages contribute to the Travel and Traffic Management user services:

1. Pre-Trip Travel Information
2. Driver Advisory
3. Route Guidance
4. Traveler Information Services

Figure 2 shows the key interfaces described in this standards package.

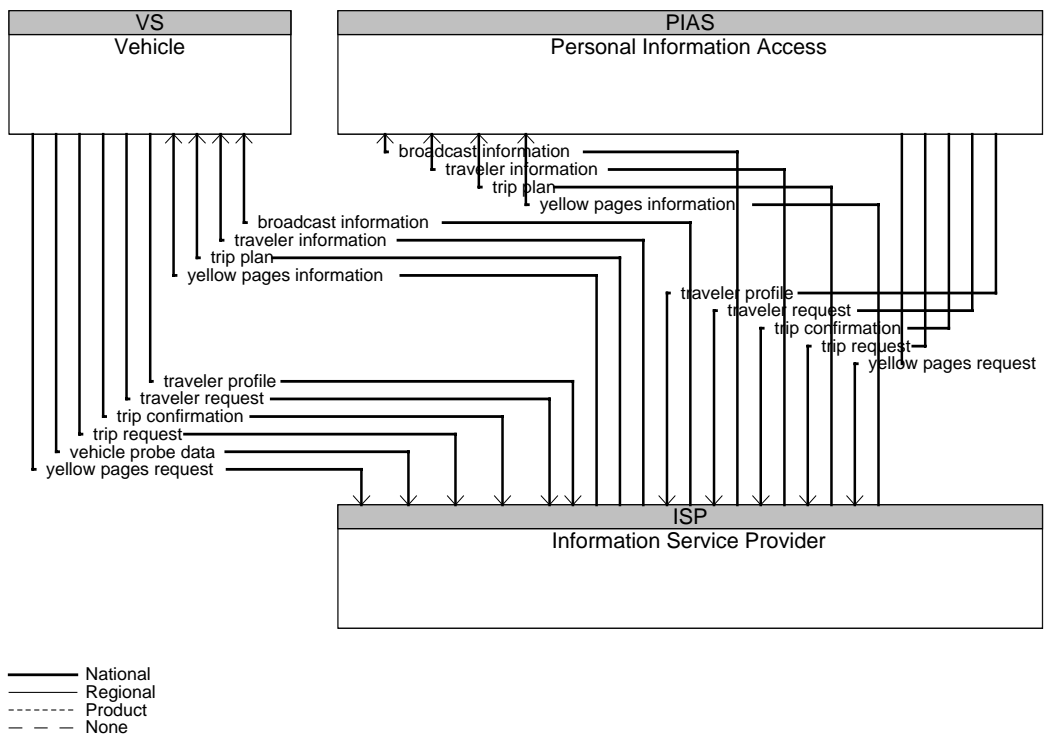
The following table lists the Architecture Flows used in this interface, identifies the source and destination subsystems of the flows and indicates which user services the flow plays a role in implementing:

**Table 1 - Map of Architecture Flow to User Services**

Architecture Flow	Source Entity	Destination Entity	Pre-Trip Travel Information	Driver Advisory	Route Guidance	Traveler Information Services
trip request	PIAS	ISP			x	
trip confirmation	PIAS	ISP			x	
traveler profile	PIAS	ISP	x	x		
traveler request	PIAS	ISP	x			
yellow pages request	PIAS	ISP				x
broadcast information	ISP	PIAS			y	
trip plan	ISP	PIAS			x	
traveler information	ISP	PIAS	x			x
yellow pages information	ISP	PIAS				x
trip confirmation	VS	ISP			x	
trip request	VS	ISP			x	
traveler profile	VS	ISP	x	x		
traveler request	VS	ISP	x	x		
yellow pages request	VS	ISP				x
vehicle probe data	VS	ISP		x		
broadcast information	ISP	VS		x	y	
trip plan	ISP	VS			x	
traveler information	ISP	VS	x	x		x
yellow pages information	ISP	VS				x



This package will need to be coordinated with the Personal Mayday in SRD Package 5: Personal, Transit, and HAZMAT Maydays, if a common set of devices will support both ATIS and Mayday.



**Figure 2 - Information Service Provider Wireless Interfaces Architecture Flows**

### 3. Transaction Sets for the Information Service Provider Wireless Interfaces

In this section we define the transaction sets needed to accomplish different ITS tasks. An operational concept diagram as well as a message sequence chart format along the lines of those defined under ISO standardization is used for clarity of presentation. The following subsections each discuss the interactions between the Information Service Provider subsystem and subsystems and terminators that the ISP communicates with over wireless interfaces.

The transaction set figures used in this chapter identify the messages that go between the ISP and the Vehicle or Personal Information Access subsystems to perform the general class of user service identified in the title of the associated subsection. Where messages follow each other top to bottom, they represent a transaction sequence or protocol. Where messages are separated by a horizontal dotted line, the separated messages are distinct, and not related in any particular sequence. A number in a circle identifies an associated numbered section in the text which describes the particular message or message sequence function.

#### 3.1. Pre-Trip Travel Information

**Figure 3** and **Figure 4** show the subsystems and high-level message sequences for the Pre-Trip Travel Information services and the associated wireless communication transactions set respectively.

1. The traveler or driver, either from a Kiosk or home/office computer interface (Remote Traveler Support subsystem), the Vehicle subsystem, or from a portable computer (Personal Information Access subsystem) issues a traveler request architecture flow (or traveler profile flow if the service is set up as a subscription type service) which is sent to the ISP (Information Service Provider subsystem).

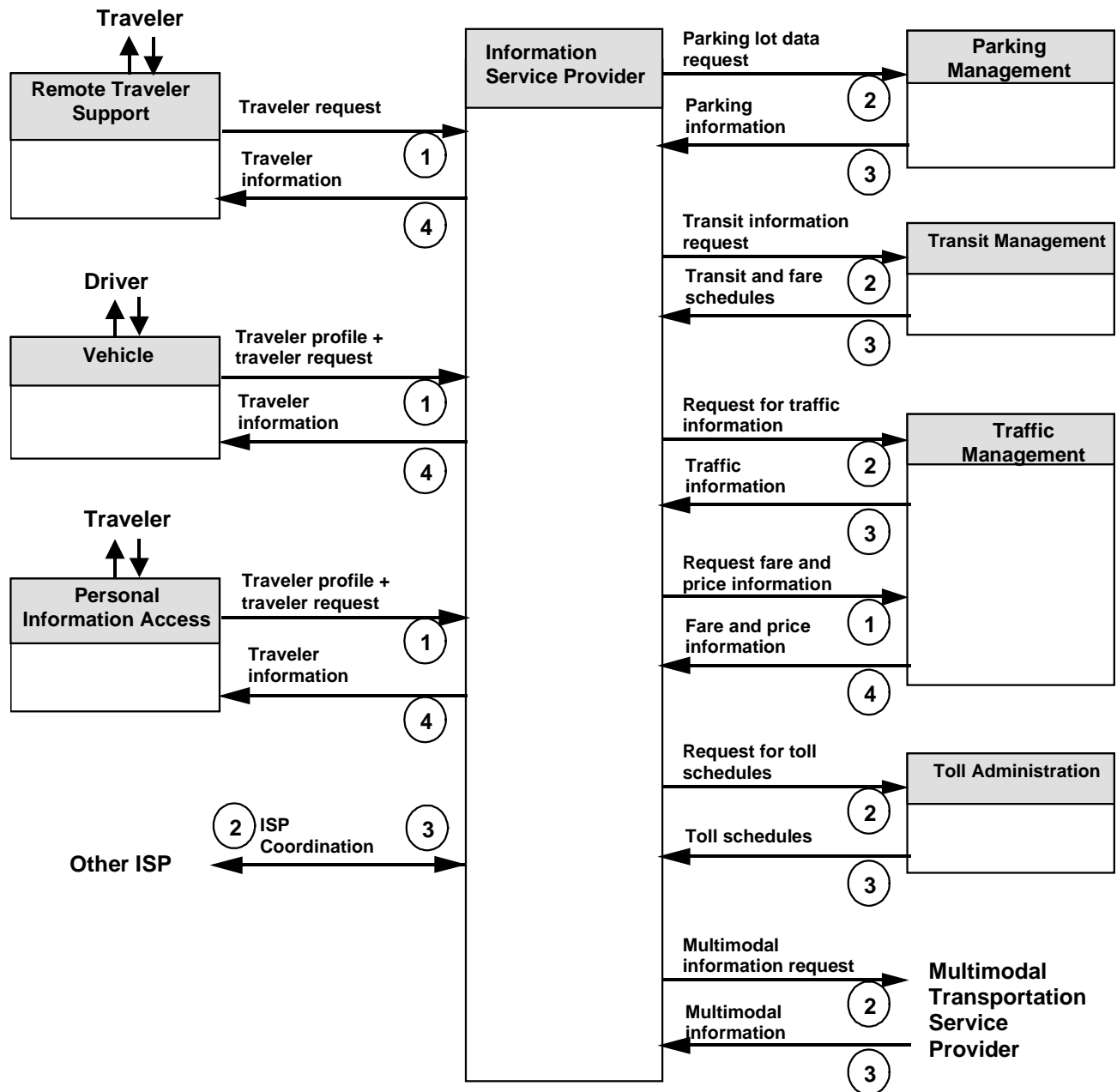
Note that the architecture does not specify the implementation of subsystems, but rather the functional requirements. For example, the Remote Traveler Support subsystem could be implemented as a “kiosk”, or as a “human operator” that interfaces with travelers over a phone line. In either case, the human interface based interaction with the traveler results in a “Traveler Request” message being issued from the Remote Traveler Support subsystem to the Information Service Provider subsystem.

In the ISP, the “Infrastructure Provided Route Selection” equipment package identifies which type of service is required and obtains information from the appropriate subsystems, if necessary, in the next two steps:

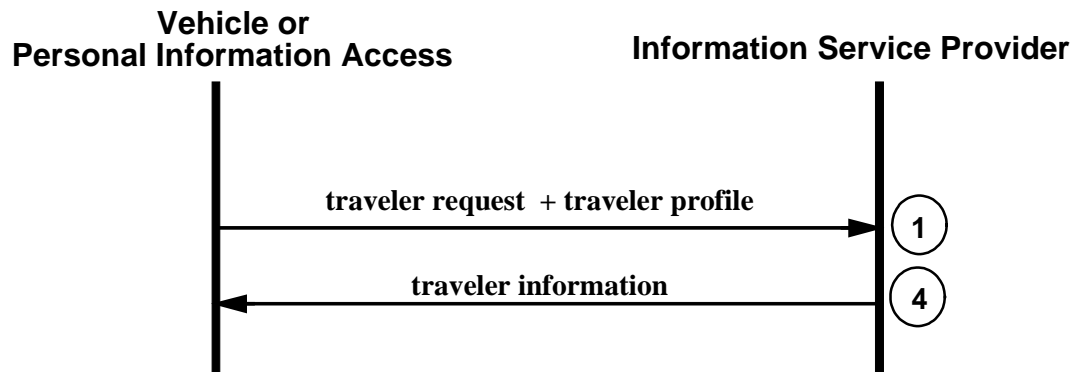
2. If demand responsive transit (paratransit) is an option then a transit trip request is sent to the Transit Center and if vehicle travel is an option then link travel times and other link conditions (e.g. incident locations and status, construction) are requested from the appropriate Traffic Management subsystem(s) and if Parking is required then a “parking reservation” is sent to one or more Parking Management subsystems and if other travel service provider modes are an option (e.g., rail, plane, ship, ferry, taxi, shuttle) then a request is sent to the appropriate “Multimodal Transportation Service Provider” external system interface.

(Note: the Transit Subsystem has its own route selection process for routing demand responsive transit vehicles for demand responsive transit passenger pick-up and delivery.)

- The response messages for portions of the trip that were just requested (in step 2 above) are sent from their respective subsystems (or terminators) and received at the ISP.



**Figure 3 - Physical Architecture for Pre-Trip Travel Information**



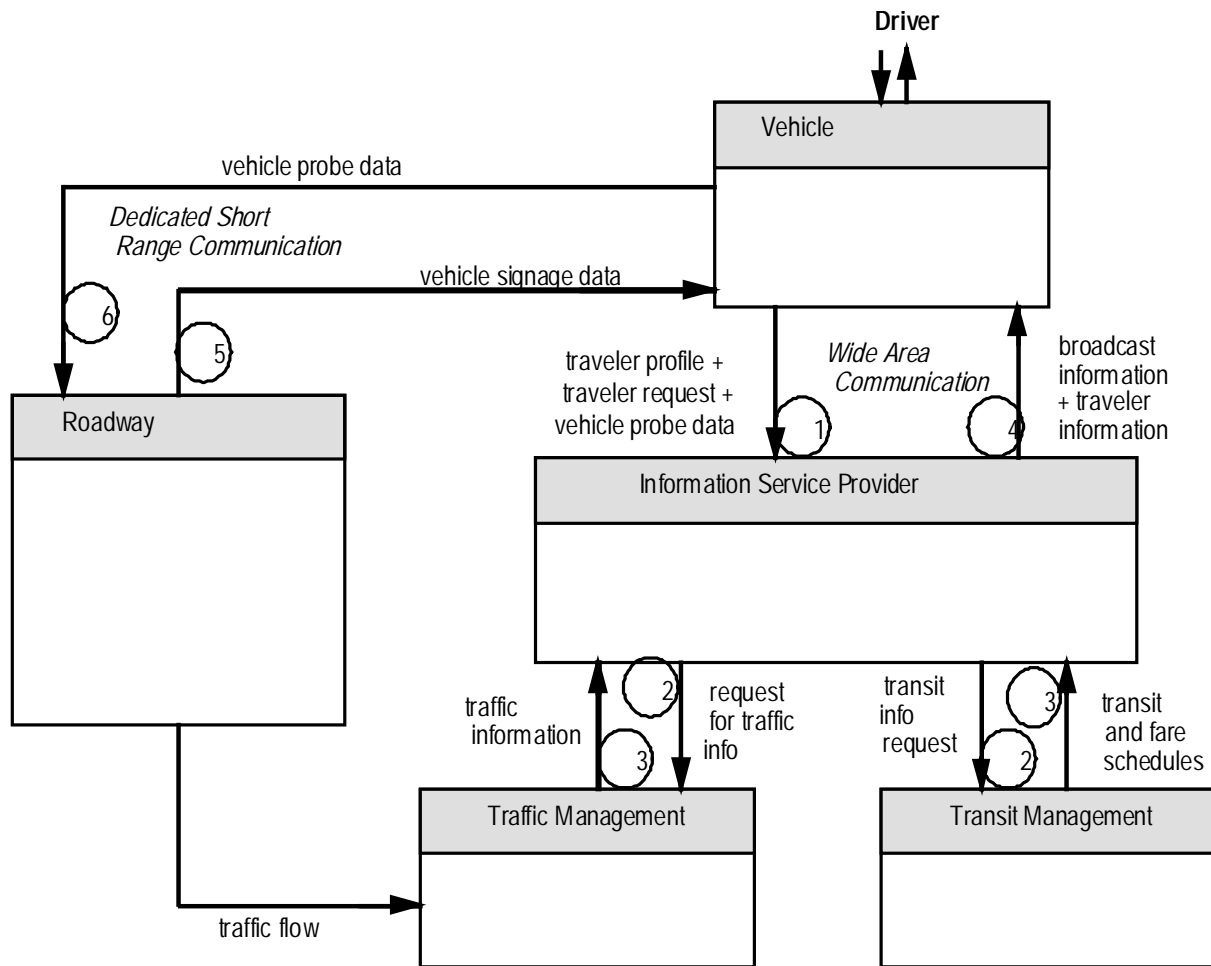
**Figure 4 - Pre-Trip Travel Information Transaction Set**

If a route is requested (either vehicular or bicycle, or pedestrian) then the traveler/driver request goes to the Infrastructure Provided Route Selection equipment package for determination of the route. If transit is a part of the trip then the Route Selection equipment package responds based upon its database of transit schedules which is updated (perhaps independently of any specific trip request) on a basis determined by the ISP. If Rideshare is requested, then the Infrastructure Provided Dynamic Ridesharing equipment package within the ISP meets this request.

4. The traveler information architecture flow response is sent by the ISP to the traveler/driver.

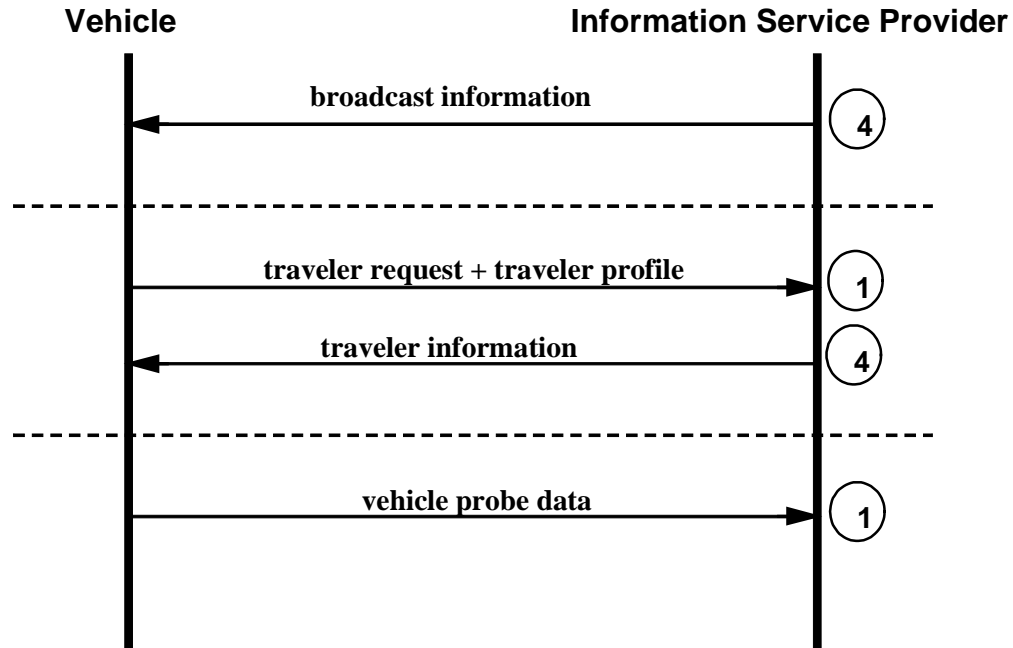
### **3.2. Driver Advisory**

The basic driver advisory service, shown in Figure 5 and Figure 6, is provided by the Information Service Provider (ISP).



**Figure 5 - Physical Architecture for Driver Advisory**

1. A driver requests advisory information (via the traveler request architecture flow or the traveler profile flow if he is part of a subscription service) through the driver interface. He also sends the vehicle location and a time-stamp (vehicle probe data), which is the simplest basis for “probe” data, since the ISP can make an estimate of traffic flow conditions based on the time and location differences between these messages from each vehicle.
2. The ISP requests advisory data from the TMS subsystem (through the architecture flow “request for traffic information”). At the same time, Transit information is requested from the Transit Management Center (TRM) via the “transit information request” architecture flow. Note that the ISP may choose to request information from the TRM and TMS at regular intervals, not related to traveler requests. If the ISP is paying for the TMS and TRM information, then the ISP will be motivated to carefully manage these information requests.



**Figure 6 - Driver Advisory Transaction Set**

The Roadway subsystem periodically updates the Traffic Management subsystem with surveillance data about roadway conditions. The TMS uses this information to maintain a real-time model of roadway conditions, so that the TMS can perform its own Traffic Management functions, and also rapidly respond to ISP requests.

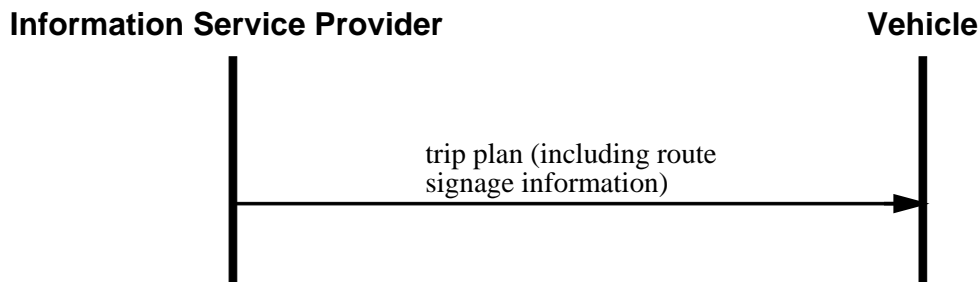
3. In response to the ISP requests, the TRM and TMS send transit and traffic/ road status back to the ISP.
4. Advisory information included in the architecture flow “traveler information” can be provided to the driver based on the driver request, or can be provided automatically (event driven) once a connection with the ISP has been initiated. In this way, the driver can be notified shortly after an incident that affects their travel plan.

### **Alternative In-Vehicle Signage Using Wireless Wide Area Communication**

An alternative approach to providing In-Vehicle Signage, shown in Figure 7 and Figure 8, from that discussed in the ITS-America Program Plan and shown in Figure 5, is also included in the National ITS architecture. This user service may be an outgrowth of the Route Selection provided by the ISP. A navigable database maintained by the ISP can contain information about the location and content of signage on the links. By adding this signage information to route messages as link attributes, it can be transmitted to the vehicle using the Wireless Wide Area Communications. When combined with an in vehicle location system, the route guidance capability in the vehicle can provide the driver with upcoming signage information. The information could be provided either by auditory, or visual means through the same driver interface used by the route guidance function.



**Figure 7 - Alternative Physical Architecture for In-Vehicle Signage**



**Figure 8 - ISP Wireless Message Sequence Diagram for In-Vehicle Signage**

Using this mechanism, signage becomes a service provided by the ISP, not constrained to be an extension of the existing infrastructure signage. An active link from roadway signs to vehicles is certainly possible, and can coexist with this alternative, but brings with it added liability on the public sector. Once the public sector provides this service they become responsible for maintaining the capability, and can suffer legal exposure if the infrastructure component fails to work. (The assumption here, which can be debated, is that the private sector may be better prepared to manage the inherent liability of the signage user service. This issue is discussed in more detail in the legal analysis section of the Implementation Plan document.) ISPs will likely exercise a choice as to what kind of signs they choose to include in routes, possibly taking driver preferences into account.

### **3.3. Route Guidance**

The Route Guidance User Service involves two distinct processing operations: route selection and route guidance. The route selection operation involves selecting the route to take based upon the Driver, Traveler (or Commercial Vehicle Dispatcher) request. The route guidance operation involves presenting the selected route to the driver or traveler in a step by step fashion. All implementations of the Route Guidance user service involve a route guidance process in the vehicle subsystem or Personal Information Access subsystem (e.g., a PDA or Personal Digital Assistant). The location of the route selection process distinguishes different Route Guidance operating modes of the architecture.

The method of providing Route Selection in the fully developed architecture, to either a driver in a vehicle, a traveler with a PDA (Personal Information Access subsystem) or at a Remote Traveler Support subsystem, or a Commercial Vehicle Manager at a Fleet Management Center, is by the Information Service Provider. The architecture supports the autonomous mode of guidance (route selection processing in the Vehicle or Personal Information Access subsystems) and also supports the mode of



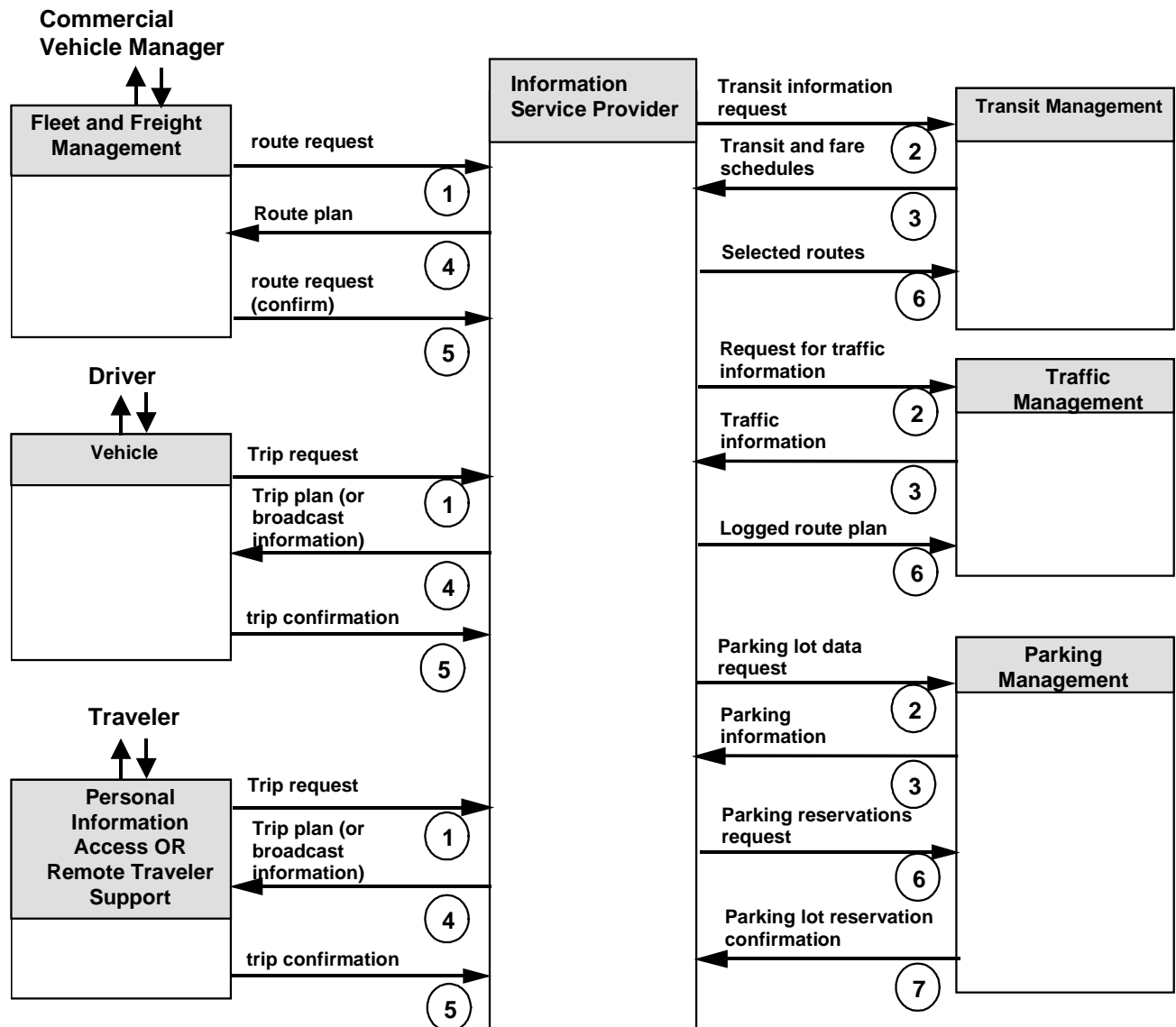
route selection in the Vehicle or Personal Information Access subsystems where the Information Service Provider provides link and queue times to the mobile route selection processes.

Another key function in providing the Route Guidance user service in the fully developed architecture is the use of a predictive model from which to estimate future transportation link and queue delay times. This process can reside in either the ISP or in the TMS (Traffic Management Subsystem). Figure 9 and Figure 10 show the high-end state Route Guidance user service where the predictive model resides in the TMS. The prediction of link delays (the time to transit a link) and ramp or intersection queue delays (the expected waiting time at a highway on-ramp, off-ramp or an intersection based on a desired turning movement) can be of varying levels of sophistication. In a sophisticated deployment, the link and queue times may be based on the expected statistical occupancy of links, and models based on historical data of the relationship between occupancy and expected (average) link times and queue delays. The expected statistical occupancy of links may be determined by historical time-of-day data, as well as the prior choices of travelers to travel specific routes (routes that have been requested and selected by travelers using an Information Service Provider subsystem). In Figure 9, these choices are communicated (without any identification of specific vehicles or travelers), by the ISP to the TMS so that the predictive model may be incrementally updated in real-time. In the same way, the expected occupancy of transit vehicles may be updated in real-time through a similar message from the ISP to the Transit Management subsystem.

1. Driver, Traveler or Commercial Vehicle Manager interacts with the corresponding subsystem to issue a Trip Request message to the ISP.
2. The ISP issues, if necessary, appropriate traffic and/or transit data requests. These requests (and waiting for the corresponding response) may not be necessary if the ISP has recently requested (and stored) similar information.
3. The ISP receives current and predicted traffic data (link travel times and ramp or intersection queue delays) and/or transit data (available schedules and schedule variances) relevant to the route request.

Based on the data received in step 3 above, the ISP may make additional requests (step 2. above) to find a better route. These steps are very dependent on the specific implementation of route selection in the ISP. It is expected that there will be considerable innovation in the development of these processes, and the performance of these processes (the quality of the resultant routes and the minimization of the transit/traffic data requests) will determine the cost-performance operating points of competing ISPs.

4. The ISP processes a route and sends it to the requesting subsystem in the Trip Plan message. (For mobile equipment that computes autonomous routes, this flow may not have a route, but just relevant link travel times or ramp or intersection queue delays that are variances from the expected values. Unless the selected route is reported to the ISP and subsequently to the TMS, there is no possibility in this case to achieve system (near) optimal use of the transportation network.) Note that this route may be of considerable size, depending on the complexity of the route. The ISP and receiving subsystem may use a data compression/decompression process at both ends to minimize the communications cost of this potentially large message. The route sent to the traveler can include a route ID associated with the computed route, so that the traveler equipment can efficiently refer to the selected route in the next step, route confirmation.
5. The driver, traveler or Commercial Vehicle Manager decides to accept or reject the provided route (making use of a "route preview" process), and may change the route request (going back to step 1 above) or accept the route, issuing the Trip Confirmation message from the mobile subsystem.

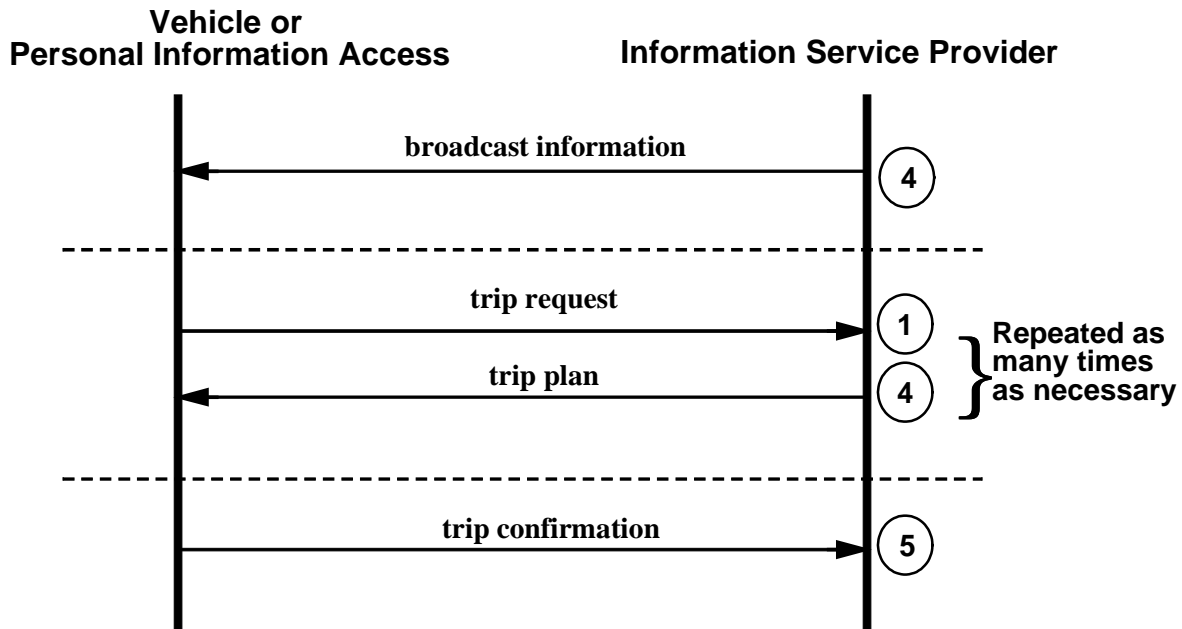


**Figure 9 - Physical Architecture for Route Guidance**

Confirming the acceptance of a route may be the basis for real-time, event-driven travel advisories to the driver or traveler, as outlined in Section 3.2. Because of this, the driver or traveler may be strongly motivated to inform the ISP of the intention to accept a selected route.

It is the responsibility of the traveler/driver to make the final decision on the selection of a route, whether the route is selected (“computed”) autonomously or at an ISP. In some cases, it may be necessary or beneficial to communicate the traveler/driver’s selection back to the ISP e.g., to confirm demand responsive transit links in the route or other reservations or to update a congestion model used by the infrastructure to compute future routes. (Note: it is in the travelers interest to have the Traffic Management congestion model updated to expect their future approximate link occupancies if the updated model is used to send suggestions to subsequent travelers to use other links, thereby leaving the links the traveler has chosen to travel in a less congested state. Furthermore, the traveler’s expected occupancy

may be used by the Traffic Management subsystem to better plan the signal timings for the traveler's benefit.)



**Figure 10 - Route Guidance Transaction Set**

6. The ISP sends the selected route to the Traffic Management Center and/or Transit Management Center (with vehicle classification and occupancy but without traveler or driver/vehicle identification) so that the appropriate expected statistical occupancy models can be updated, reflecting the incremental congestion and transit time impact that the planned route will have on the transportation network (or transit vehicle occupancy).

Note that although personal identification of vehicles is not included in the message from the ISP to the TMS (because it is not needed), the *type* of vehicle may be included because different type vehicles will have different impacts on the road network occupancy (i.e. a large truck will occupy more space than a passenger vehicle and will have different acceleration, deceleration, and environmental profiles). Also, vehicle occupancy is communicated in support of traffic control optimization based on movement of people (as opposed to vehicles). Another exception is for commercial vehicles transporting hazardous materials (HAZMAT). In these cases, the selected route may also include the hazardous materials manifest, each item identified by the material safety data sheet number (MSDS, a standard for identifying hazardous materials) and the material quantity. The purpose of this information is for public safety purposes: emergency pre-planning and accelerating incident classification and (appropriate) response.

### **Dynamic Route Selection and Probe Data**

A variation of the basic Route Guidance mechanism supported by the architecture involves the mobile subsystem frequently requesting a new route from the ISP at pre-specified waypoints along a route. These additional trip requests can be used to recompute the route for the driver or traveler, and if the new route is better than the old route (due to some unanticipated change in link, ramp or intersection characteristics, e.g., a nonrecurring incident) by some user specified criteria, then the new route is sent to the mobile subsystem as in flow "4" of Figure 9.

The waypoints for the additional trip requests are pre-specified by the ISP in the original route message, and the waypoint route requests need only take the form of a location and a timestamp (the return address of the mobile subsystem is assumed to be included as a part of the message protocol below the application layer).

Finally, the waypoint specified route locations for updated route request messages serve the ISP as “probe data”, which may allow ISPs to construct their own models of the transportation network to be used for route selection. This capability of ISPs to build their own models of the transportation network may be significant in the time period before ISPs and TMSs integrate the ATIS and ATMS functions, or in regions where the TMS chooses not to participate or does not exist, and will allow competing ISPs to differentiate their services. The probe information is determined by computing the timestamp difference between a vehicle’s route request message at the current waypoint and the previous waypoint.

### **3.4. Traveler Services Information**

Traveler Services Information includes getting traffic information, transit information, and yellow pages information (e.g., tourist attractions, lodging, and motorist services). This information can be accessed by travelers at kiosks, in transit vehicles, home or office computers, travelers with Personal Digital Assistants (PDAs), and by drivers.

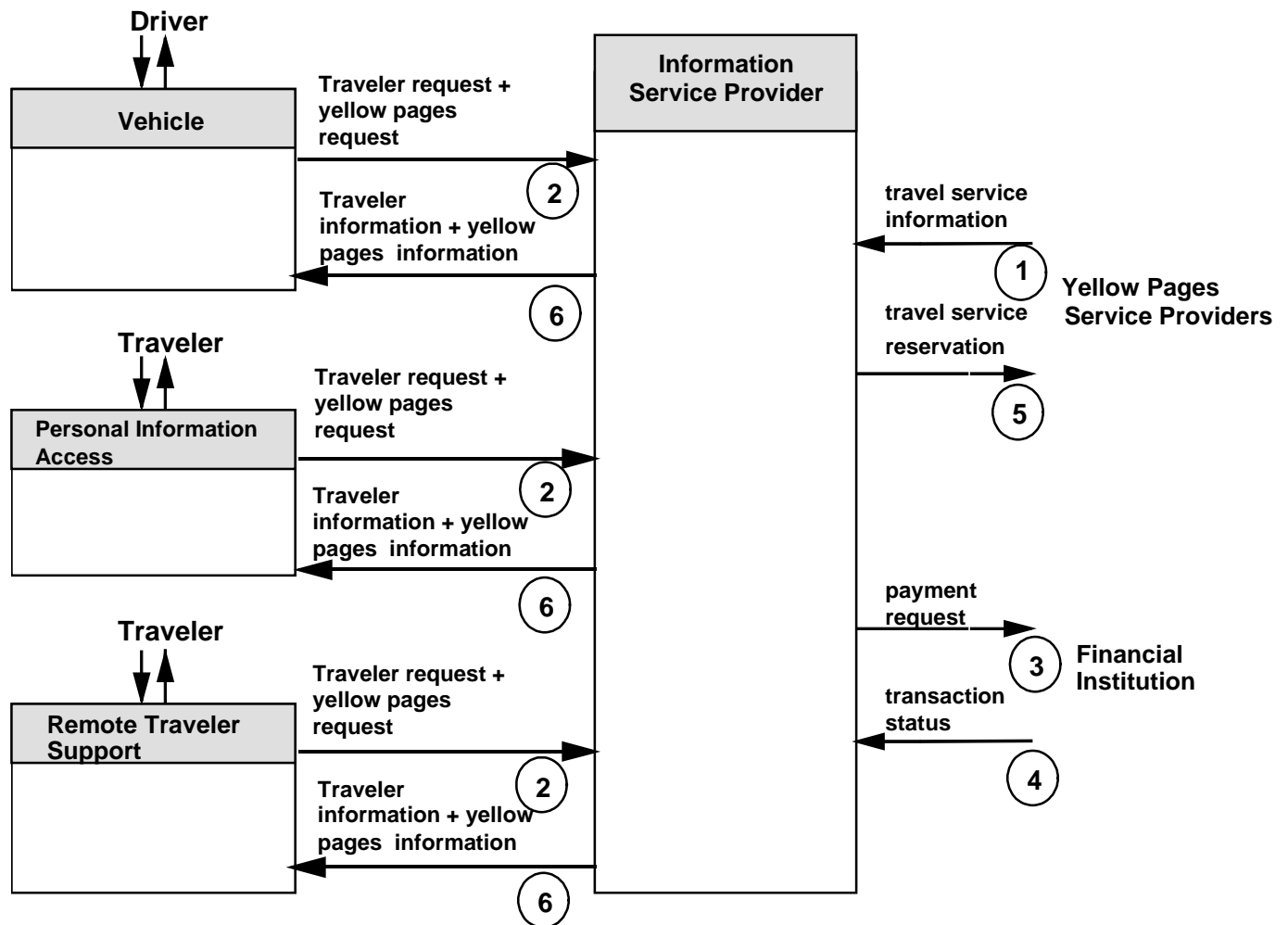
The yellow pages service includes a two-way reservation capability, including electronic payment for reservations.

The ISP supports data collection from Information Brokers (for generic yellow pages information) and Event Promoters (for information that will have a predictable impact on the transportation network) shown in Figure 11 and Figure 12. This data collection can be in response to a specific Information Request or may be collected whenever the Event Promoters or Yellow Pages Service Providers issue their specific messages. Note that it will be in the interest of the Yellow Pages Service Providers to issue the travel service info message frequently to assure its accuracy, since the providers of the information (the product or service vendors) are probably paying the information brokers to get the broadest possible distribution of their listings.

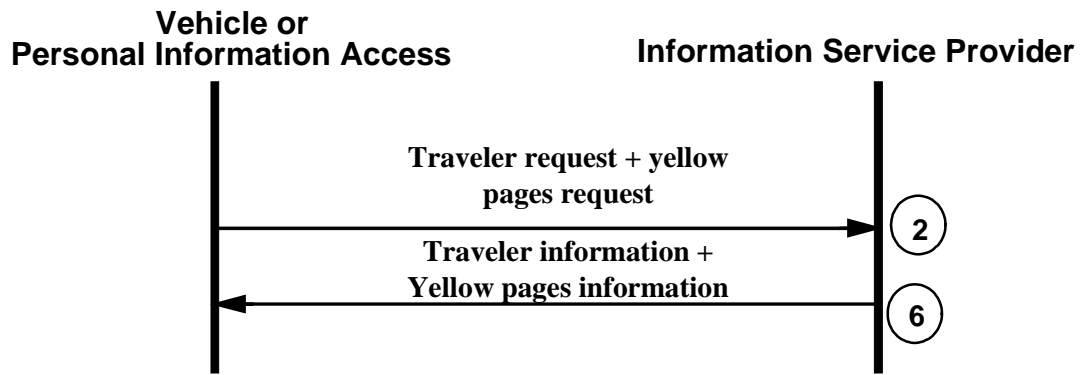
Note that the architecture does not specify implementation, so that the Remote Traveler Support subsystem of Figure 11 could be implemented with a “kiosk” type electronic interface, or with a human operator implementing the interface. In this way, a traveler could interface with the subsystem through electronic input / output devices, or through the operator, including speaking with the operator over a telephone line.

1. Travel service information from Yellow Pages Service Providers are collected whenever they are made available and then stored in the ISP.
2. Drivers or travelers from the three remote access subsystems shown in Figure 11 prepare and issue a yellow pages request message to the ISP. The request can be only for information, or can request a reservation with optional payment service in support of the reservation.
3. If necessary, the ISP issues a payment request message to the Financial Institution (or Financial Clearinghouse) to transact payment. The payment could be for the information, or (more likely) for reservations for travel services.

4. If a payment request was issued by the ISP, then the financial institution issues an acknowledgment (that payment was transacted or denied).
5. If a travel service reservation was requested, then the ISP issues a message with the reservation and payment confirmation information to the Yellow Pages Service Provider.
6. The ISP returns the yellow pages information message to the requesting subsystem. This message will contain confirmation for the various traveler services requested, if any.



**Figure 11 - Physical Architecture for Traveler Information Services**



**Figure 12 - Traveler Information Services Transaction Set**

## 4. Interface Decomposition

This section shows the interface decomposition for the interfaces covered in this package. The format shows the interface followed by the first physical architecture data flow in the interface and its description. Each of the physical architecture flows is then decomposed into its constituent leveled data items, which in turn are decomposed hierarchically into more basic leveled architecture flows. The leveled data items are numbered and indented to indicate which are top level flows (1) and which are constituent data flows (numbered 2 and lower). The description of the top level leveled data item is given. The full leveled data item definition for the top level flows and for all the constituent flows is given in Section 7. That section contains the leveled data item entries, listed in alphabetical order, for all of the leveled data items contained in this package. The leveled data items represent a simplification of the logical architecture information to focus on the essential data on each subsystem interface. They are traceable to the original logical architecture data elements, and have been developed in order to provide traceability between the ITS standards being developed and the National ITS Architecture. Once a draft standard has been developed the question that must be addressed is whether the standard completely addresses all elements of the National ITS Architecture interface. Due to the complex hierarchical nature of the Logical Architecture data flows, comparison with standards outputs is very difficult. By creating a simplified view of each interface, it is possible to more effectively trace the standards outputs to the National ITS Architecture.

### 4.1. Personal Information Access -> Information Service Provider

#### **Physical Architecture Flow: traveler profile**

W,U1t

Information about a traveler including equipment capabilities, personal preferences and recurring trip characteristics.

#### **Leveled Data Items:**

##### **(1) *traveler\_contact\_setting***

This data item contains traveler's contact information to be used in his personal profile for obtaining travel information.

##### **(1) *traveler\_device\_setting***

This data item contains information about the device used by the traveler to access travel information. The data item contains a setting identity (so there can be multiple device settings per user), and specifics of the device which could include type of hardware, type of software, or modem speed and characteristics.

##### **(1) *traveler\_identity***

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

##### **(1) *traveler\_traffic\_preference\_setting***

This data item contains information about the travelers preferences for receipt of traffic data.

##### **(1) *traveler\_transit\_preference\_setting***

This data item contains information about the travelers preferences for receipt of transit data.

#### **Physical Architecture Flow: traveler request**

W,U1t

Request by a traveler to summon assistance, request information, make a reservation, or initiate any other traveler service.

#### **Leveled Data Items:**

##### **(1) *traffic\_data\_personal\_request***

This data item contains the request for the provision of traffic data for output at a traveler's personal

device.

(2) *traveler\_identity*

(1) *transit\_deviations\_personal\_request*

This data item is a request for data on current transit service deviations for output to a traveler's personal device. When a portable device is being used by the traveler. The request can be modified so that only the data for a transit route specified by the traveler from the portable device is requested.

(2) *transit\_route\_number*

(2) *transit\_vehicle\_deviation\_request*

(2) *traveler\_identity*

(1) *traveler\_map\_update\_payment\_request*

This data item contains a request that payment be made for an update of the navigable map database used by the traveler for on-line personal guidance. The payment will be made by debiting the credit identity with the cost through the financial institution terminator.

(2) *credit\_identity*

(2) *navigable\_map\_traveler\_update\_cost*

(2) *traveler\_identity*

(1) *traveler\_personal\_current\_condition\_request*

This data item contains a request for details of the current conditions, e.g. weather, events, incidents, etc. The request includes the identity of the personal device from which the request was input by the traveler so that the response can be correctly returned.

(2) *traveler\_identity*

(1) *traveler\_personal\_display\_update\_payment\_request*

This data item contains a request that payment be made for an update of the digitized map data used as background to the displays of traffic and travel information on a traveler's personal device.

(2) *credit\_identity*

(2) *display\_map\_traveler\_update\_cost*

(2) *traveler\_identity*

**Physical Architecture Flow: trip confirmation**

W,U1t

Acknowledgement by the driver/traveler of acceptance of a route.

**Leveled Data Items:**

(1) *credit\_identity*

This data item contains the identity number of a credit card which is to be used to secure preclearance from paying dues, taxes, and other commercial vehicles charges, or by a traveler or driver for payment of current or advanced tolls, fares, parking lot charges, or for yellow pages services.

(1) *paratransit\_service\_confirmation*

This data item confirms that the traveler wants to use the previously identified paratransit service.

(2) *paratransit\_service\_identity*

(2) *transit\_confirmation\_flag*

(2) *traveler\_identity*



(1) ***parking\_space\_requirements***

This data item specifies the time, location, and specific parking space requirements for a particular user.

(1) ***stored\_credit***

This data item contains the value of the credit currently stored by the payment instrument.

(1) ***toll\_route\_segment\_list***

This data item contains a list of the identities of toll segments for which toll payment is being provided or requested. Toll segments occur in about the same frequency as the percentage of toll road miles to total freeway miles.

(1) ***transit\_route\_segment\_list***

This data item contains a list of the transit route segments that make up a particular transit route, plus the cost to a transit user for using each segment and the identity of the road or freeway link(s) over which the route segment runs.

(2) ***link\_identity\_list***

(2) ***transit\_route\_segment\_cost***

(2) ***transit\_route\_segment\_number***

(1) ***traveler\_identity***

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

(1) ***traveler\_rideshare\_confirmation***

This data item contains a traveler's request to confirm a rideshare based trip.

(2) ***credit\_identity***

(2) ***reservation\_status***

(3) ***confirmation\_flag***

(2) ***rideshare\_selection\_number***

(2) ***traveler\_identity***

(1) ***traveler\_route\_accepted***

This data item contains the acceptance by the traveler of the previously provided route for on-line infrastructure based guidance. Acceptance must be provided before guidance can begin.

(2) ***route\_identity***

**Physical Architecture Flow: trip request**

**W,U1t**

Request by a driver/traveler for special routing.

**Leveled Data Items:**

(1) ***traveler\_identity***

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

(1) ***traveler\_personal\_trip\_request***

This data item contains a request for personally tailored trip information.

(2) ***traveler\_identity***

(2) ***traveler\_rideshare\_request***

(3) ***origin***

- (3) *traveler\_identity*
- (3) *traveler\_rideshare\_constraints*
  - (4) *constraint\_on\_acceptable\_travel\_time*
  - (4) *constraint\_on\_ahs\_lanes*
  - (4) *constraint\_on\_eta\_change*
  - (4) *constraint\_on\_interstate*
  - (4) *constraint\_on\_special\_needs*
  - (4) *constraint\_on\_urban*
  - (4) *constraint\_on\_vehicle\_type*
- (3) *traveler\_rideshare\_data*
  - (4) *departure\_time*
  - (4) *desired\_arrival\_time*
  - (4) *destination*
  - (4) *origin*
- (3) *traveler\_rideshare\_preferences*
  - (4) *preferred\_alternate\_routes*
  - (4) *preferred\_ridesharing\_options*
  - (4) *preferred\_route\_segments*
  - (4) *preferred\_routes*
- (2) *trip\_request*
  - (3) *constraints*
    - (4) *constraint\_on\_acceptable\_travel\_time*
    - (4) *constraint\_on\_ahs\_lanes*
    - (4) *constraint\_on\_eta\_change*
    - (4) *constraint\_on\_interstate*
    - (4) *constraint\_on\_load\_classification*
    - (4) *constraint\_on\_number\_of\_mode\_changes*
    - (4) *constraint\_on\_number\_of\_transfers*
    - (4) *constraint\_on\_special\_needs*
    - (4) *constraint\_on\_urban*
    - (4) *constraint\_on\_vehicle\_type*
  - (3) *departure\_time*
  - (3) *desired\_arrival\_time*
  - (3) *destination*
  - (3) *modes*
  - (3) *origin*
  - (3) *preferences*
    - (4) *modes*
    - (4) *preferred\_alternate\_routes*
    - (4) *preferred\_ridesharing\_options*
    - (4) *preferred\_route\_segments*

- (4) *preferred\_routes*
- (4) *preferred\_transit\_options*
- (4) *preferred\_weather\_conditions*

(1) *traveler\_rideshare\_request*

This data item contains a request for rideshare information.

- (2) *origin*
- (2) *traveler\_identity*
- (2) *traveler\_rideshare\_constraints*
  - (3) *constraint\_on\_acceptable\_travel\_time*
  - (3) *constraint\_on\_ahs\_lanes*
  - (3) *constraint\_on\_eta\_change*
  - (3) *constraint\_on\_interstate*
  - (3) *constraint\_on\_special\_needs*
  - (3) *constraint\_on\_urban*
  - (3) *constraint\_on\_vehicle\_type*
- (2) *traveler\_rideshare\_data*
  - (3) *departure\_time*
  - (3) *desired\_arrival\_time*
  - (3) *destination*
  - (3) *origin*
- (2) *traveler\_rideshare\_preferences*
  - (3) *preferred\_alternate\_routes*
  - (3) *preferred\_ridesharing\_options*
  - (3) *preferred\_route\_segments*
  - (3) *preferred\_routes*

(1) *traveler\_route\_request*

This data item contains data from which the route requested by a traveler can be determined, or that the previously provided data has been accepted.

- (2) *desired\_arrival\_time*
- (2) *destination*
- (2) *origin*
- (2) *traveler\_identity*
- (2) *traveler\_location*
  - (3) *location\_identity*
- (2) *traveler\_route\_accepted*
  - (3) *route\_identity*
- (2) *traveler\_route\_constraints*
  - (3) *constraint\_on\_acceptable\_travel\_time*

- (3) *constraint\_on\_eta\_change*
- (3) *constraint\_on\_number\_of\_mode\_changes*
- (3) *constraint\_on\_number\_of\_transfers*
- (3) *constraint\_on\_special\_needs*
- (2) *traveler\_route\_preferences*
  - (3) *modes*
  - (3) *preferred\_alternate\_routes*
  - (3) *preferred\_ridesharing\_options*
  - (3) *preferred\_route\_segments*
  - (3) *preferred\_routes*
  - (3) *preferred\_transit\_options*

**Physical Architecture Flow: yellow pages request**

W,U1t

Request for information through a yellow pages type service.

**Leveled Data Items:**

(1) *traveler\_personal\_transaction\_request*

This data item contains data input by the traveler at a personal device to make reservations for various other (yellow pages) services.

- (2) *yellow\_pages\_dining\_reservation*
- (2) *yellow\_pages\_lodging\_reservation*
- (2) *yellow\_pages\_ticket\_purchase*

(1) *traveler\_personal\_yellow\_pages\_information\_request*

This data item contains a request for data on other (yellow pages) services to be provided to a traveler using a personal device. The traveler identity is used as the means of ensuring that the data produced in response to the request is returned to the correct traveler. As no filtering components are included, all the data currently available will be provided.

- (2) *traveler\_identity*

## 4.2. Vehicle -> Information Service Provider

**Physical Architecture Flow: traveler profile**

U1t

Information about a traveler including equipment capabilities, personal preferences and recurring trip characteristics.

**Leveled Data Items:**

(1) *traveler\_traffic\_profile*

This data item contains a traveler's personal profile for obtaining traffic information. This profile is submitted one time and then used to generate future personalized trip information. This profile supports a subscription type of information dissemination to the traveler.

- (2) *traveler\_contact\_setting*
- (2) *traveler\_device\_setting*
- (2) *traveler\_identity*

(2) *traveler\_traffic\_preference\_setting*

(1) *traveler\_transit\_profile*

This data item contains a traveler's personal profile for obtaining transit information. This profile is submitted one time and then used to generate future personalized trip information. This profile supports a subscription type of information dissemination to the traveler.

(2) *traveler\_contact\_setting*

(2) *traveler\_device\_setting*

(2) *traveler\_identity*

(2) *traveler\_traffic\_preference\_setting*

**Physical Architecture Flow: traveler request**

Ult

Request by a traveler to summon assistance, request information, make a reservation, or initiate any other traveler service.

**Leveled Data Items:**

(1) *advanced\_fare\_details*

This data item contains details of the transit ride for which a driver wishes to make an advanced payment.

(2) *credit\_identity*

(2) *stored\_credit*

(2) *transit\_journey\_date*

(2) *transit\_route\_destination*

(2) *transit\_route\_origin*

(1) *advanced\_parking\_lot\_charges*

This data item contains data to enable an advanced parking lot charge to be calculated and billed.

(2) *credit\_identity*

(2) *parking\_lot\_identity\_list*

(2) *parking\_space\_requirements*

(2) *stored\_credit*

(2) *vehicle\_identity*

(1) *advanced\_tolls*

This data item contains data to enable an advanced toll to be calculated and billed.

(2) *credit\_identity*

(2) *stored\_credit*

(2) *toll\_route\_segment\_list*

(2) *vehicle\_identity*

(1) *advisory\_data\_request*

This data item is used to request that advisory data be output to a driver or a traveler in a vehicle. The scope and transit route number data will be provided by the driver or transit user,

while the vehicle location will be provided automatically.

(2) *advisory\_data\_scope*

(2) *transit\_route\_number*

(2) *transit\_vehicle\_identity*

(2) *vehicle\_location\_for\_advisories*

(3) *location\_identity*

(1) *driver\_map\_update\_payment\_request*

This data item contains a request that payment be made for an update of the navigable map database used for on-line vehicle guidance. The payment will be made by debiting the credit identity with the cost through the financial institution terminator.

(2) *credit\_identity*

(2) *navigable\_map\_vehicle\_update\_cost*

(2) *vehicle\_identity*

**Physical Architecture Flow: trip confirmation**

U1t

Acknowledgement by the driver/traveler of acceptance of a route.

**Leveled Data Items:**

(1) *vehicle\_guidance\_route\_accepted*

This data item contains the acceptance by the driver of the previously provided route for on-line guidance. Acceptance must be provided before guidance can begin.

(2) *route\_identity*

**Physical Architecture Flow: trip request**

U1t

Request by a driver/traveler for special routing.

**Leveled Data Items:**

(1) *vehicle\_route\_request*

This data item contains a request for on-line guidance of the vehicle. This will have been generated by the driver and will include the necessary source and destination data from which a route can be computed.

(2) *departure\_time*

(2) *desired\_arrival\_time*

(2) *destination*

(2) *origin*

(2) *vehicle\_identity*

(2) *vehicle\_location\_for\_dynamic\_guidance*

(3) *location\_identity*

(2) *vehicle\_route\_constraints*

(3) *constraint\_on\_acceptable\_travel\_time*

(3) *constraint\_on\_ahs\_lanes*

(3) *constraint\_on\_eta\_change*

(3) *constraint\_on\_interstate*

- (3) *constraint\_on\_load\_classification*
- (3) *constraint\_on\_special\_needs*
- (3) *constraint\_on\_urban*
- (3) *constraint\_on\_vehicle\_type*
- (2) *vehicle\_route\_preferences*
  - (3) *preferred\_alternate\_routes*
  - (3) *preferred\_route\_segments*
  - (3) *preferred\_routes*

**Physical Architecture Flow: vehicle probe data**

U1t

Vehicle probe data indicating identity, route segment identity, link time and location.

**Leveled Data Items:**

(1) *route\_segment\_identity*

This data item identifies a route segment by name, location, or other standard location reference.

(1) *time*

This data item contains the current time of day and will be associated with other data flows and (possibly) a date.

(1) *vehicle\_identity*

This data item contains the identity of a vehicle.

**Physical Architecture Flow: yellow pages request**

U1t

Request for information through a yellow pages type service.

**Leveled Data Items:**

(1) *advisory\_data\_scope*

This data item shows the scope of the advisory data requested by the driver or transit user from a vehicle. It can be used to characterize the type of traffic, transit, or yellow pages data requested.

(1) *transit\_route\_number*

This data item identifies a regular transit route.

(1) *transit\_vehicle\_identity*

This data item contains the identity of an individual transit vehicle. This data is used to identify the source and/or ownership of other data.

(1) *vehicle\_location\_for\_advisories*

This data item contains the vehicle's location as computed from data input to sensors controlled by the processes that determines vehicle location. This is a low precision data flow that has sufficient accuracy for filtering traveler and driver in-vehicle advisory data to make it relevant to the current geographic area where the vehicle is located.

(1) *yellow\_pages\_dining\_reservation*

This data item contains a request for the information and service providers to make a dining reservation at a restaurant, hotel, etc. The reservation will be based on the data already provided to the traveler through a previous request.

(1) *yellow\_pages\_lodging\_reservation*

This data item contains a request for the information and service providers to make a lodging reservation at a hotel or motel etc. from the information already provided to the traveler through a previous request.

(1) *yellow\_pages\_ticket\_purchase*

This data item contains a request for the information and service providers to make a ticket purchase for a special event, theater, tourist attraction, etc. from the information already provided to the traveler through a previous request.

### **4.3. Information Service Provider -> Personal Information Access**

**Physical Architecture Flow: broadcast information**

W,U1b

General broadcast information that contains link travel times, incidents, advisories, transit services and a myriad of other traveler information.

**Leveled Data Items:**

(1) *traffic\_data\_for\_broadcast\_to\_personal\_devices*

This data item is used to provide broadcast data on the traffic flowing in the road network, plus that which is predicted to flow in the network for output to a traveler's personal device.

(2) *area\_air\_quality\_index*

(2) *current\_highway\_network\_data*

(3) *link\_delay*

(3) *link\_list\_for\_highways*

(3) *link\_travel\_time*

(2) *current\_road\_network\_data*

(3) *link\_delay*

(3) *link\_list\_for\_roads*

(3) *link\_travel\_time*

(2) *incident\_data*

(3) *incident\_description*

(3) *incident\_duration*

(3) *incident\_location*

(3) *incident\_number*

(3) *incident\_severity*

(3) *incident\_start\_time*

(3) *incident\_traffic\_impact*

(3) *incident\_type*

(3) *incident\_vehicles\_involved*

(2) *link\_state\_data\_for\_broadcast*

(3) *link\_delay*

(3) *link\_list*

(3) *link\_travel\_time*

(3) *vehicle\_occupancy*

(3) *vehicle\_speed*

(2) *parking\_lot\_storage\_data\_list*



- (3) *parking\_lot\_current\_occupancy*
- (4) *parking\_lot\_calculated\_occupancy*
- (4) *parking\_lot\_identity*
- (3) *parking\_lot\_identity*
- (3) *parking\_lot\_state*
- (2) *predicted\_highway\_network\_data*
  - (3) *link\_delay*
  - (3) *link\_list\_for\_highways*
  - (3) *link\_occupancy*
  - (3) *link\_speed*
  - (3) *link\_travel\_time*
- (2) *predicted\_parking\_lot\_data*
  - (3) *parking\_lot\_identity*
  - (3) *parking\_lot\_occupancy*
  - (3) *parking\_lot\_state*
- (2) *predicted\_road\_network\_data*
  - (3) *link\_delay*
  - (3) *link\_list\_for\_roads*
  - (3) *link\_occupancy*
  - (3) *link\_speed*
  - (3) *link\_travel\_time*
- (2) *roadway\_environment\_conditions*
  - (3) *link\_environment\_conditions*
  - (3) *link\_list\_identities*
- (2) *source\_identity*

(1) *transit\_deviations\_for\_broadcast\_to\_pers\_devices*

This data item contains current transit service deviations for a particular route to be broadcast to a traveler's personal device.

- (2) *transit\_vehicle\_schedule\_deviations\_list*
  - (3) *transit\_route\_number*
  - (3) *transit\_route\_segment\_number*
  - (3) *transit\_vehicle\_achieved\_time*
  - (3) *transit\_vehicle\_identity*

**Physical Architecture Flow: traveler information**

W,U1t

Traveler information comprised of traffic status, advisories, incidents, payment information and many other travel-related data updates and confirmations.

**Leveled Data Items:**

(1) *area\_air\_quality\_index*

This data item contains a code for the area wide air quality level.

(1) ***incident\_data***

This data item contains current incident information.

(2) ***incident\_description***

(2) ***incident\_duration***

(2) ***incident\_location***

(2) ***incident\_number***

(2) ***incident\_severity***

(2) ***incident\_start\_time***

(2) ***incident\_traffic\_impact***

(2) ***incident\_type***

(2) ***incident\_vehicles\_involved***

(1) ***link\_performance\_data***

This data item contains speed and occupancy on each link within the road (surface street) and highway network in the geographic area relevant to the user.

(2) ***link\_delay***

(2) ***link\_list***

(2) ***link\_travel\_time***

(2) ***vehicle\_occupancy***

(2) ***vehicle\_speed***

(1) ***parking\_lot\_storage\_data\_list***

This data item contains a list of occupancy and state data for one or more parking lots in a local geographic area.

(2) ***parking\_lot\_current\_occupancy***

(3) ***parking\_lot\_calculated\_occupancy***

(3) ***parking\_lot\_identity***

(2) ***parking\_lot\_identity***

(2) ***parking\_lot\_state***

(1) ***predicted\_highway\_network\_data***

This data item contains data about predicted traffic conditions on links in the highway network served by the function.

(2) ***link\_delay***

(2) ***link\_list\_for\_highways***

(2) ***link\_occupancy***

(2) ***link\_speed***

(2) ***link\_travel\_time***

(1) ***predicted\_parking\_lot\_data***

This data item contains predicted parking lot states produced by the predictive model process.

(2) ***parking\_lot\_identity***

(2) ***parking\_lot\_occupancy***

(2) ***parking\_lot\_state***

(1) ***predicted\_road\_network\_data***

This data item contains data about predicted traffic conditions on links in the road network served by the function.

(2) ***link\_delay***

(2) ***link\_list\_for\_roads***

(2) ***link\_occupancy***

(2) ***link\_speed***

(2) ***link\_travel\_time***

(1) ***roadway\_environment\_conditions***

This data item contains processed environment sensor information which provides a summary of environment conditions referenced to a link.

(2) ***link\_environment\_conditions***

(2) ***link\_list\_identities***

(1) ***source\_identity***

This data item defines the logical identifier of a source of information.

(1) ***transit\_deviations\_for\_personal\_devices***

This data item contains current transit service deviations for a particular route. This data will be output to a traveler's personal device.

(2) ***transit\_route\_segment\_number***

(2) ***transit\_vehicle\_achieved\_time***

(2) ***transit\_vehicle\_identity***

(2) ***traveler\_identity***

(1) ***traveler\_identity***

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

(1) ***traveler\_map\_update\_payment\_response***

This data item contains the response to a previous request from the traveler that payment be made for an update of the navigable map database used for on-line traveler guidance.

(2) ***credit\_identity***

(2) ***traveler\_identity***

(1) ***traveler\_personal\_display\_update\_payment\_response***

This data item contains the response to a previous request from the traveler that payment be made for an update of the digitized map data used as background to the displays of traffic and travel information on a

traveler's personal device.

(2) *credit\_identity*

(2) *traveler\_identity*

(1) *traveler\_personal\_payment\_confirmation*

This data item indicates the payment for a confirmed trip has been successfully completed, or that the total cost can now be deducted from the credit stored on the traveler's payment instrument.

(2) *advanced\_fares\_confirm*

(2) *advanced\_tolls\_confirm*

(3) *credit\_identity*

(3) *stored\_credit*

(3) *toll\_cost*

(2) *credit\_identity*

(2) *stored\_credit*

(2) *traveler\_identity*

(2) *traveler\_total\_trip\_cost*

(1) *traveler\_personal\_transaction\_confirmation*

This data item confirms any reservations made by the traveler from a personal device. These reservations will be based on information obtained by the traveler from previous data input and output through the device.

(2) *credit\_identity*

(2) *traveler\_identity*

(2) *yellow\_pages\_dining\_reservation\_confirmation*

(2) *yellow\_pages\_lodging\_reservation\_confirmation*

(2) *yellow\_pages\_ticket\_purchase\_confirmation*

**Physical Architecture Flow: trip plan**

W,UIt

A sequence of links and special instructions comprising of a trip plan indicating efficient routes for navigating the links. Normally coordinated with traffic conditions, other incidents, preemption and prioritization plans.

**Leveled Data Items:**

(1) *traveler\_identity*

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

(1) *traveler\_personal\_trip\_information*

This data item contains information about a proposed trip that the traveler has requested earlier from the personal device.

(2) *current\_conditions*

(3) *current\_weather\_from\_weather\_service*

(3) *incident\_duration*

- (3) *incident\_location*
  - (3) *incident\_start\_time*
  - (3) *incident\_type*
  - (3) *predicted\_weather\_from\_weather\_service*
  - (2) *paratransit\_personal\_schedule*
  - (2) *rideshare\_response*
    - (3) *rideshare\_details*
    - (3) *rideshare\_selection\_number*
    - (3) *traveler\_identity*
  - (1) *traveler\_route*
- This data item describes all the details of a specific traveler's route. This data item includes the information required to provide an initial route or a route change while enroute.

- (2) *route\_cost*
- (2) *route\_identity*
- (2) *route\_start\_time\_date*
- (2) *route\_statistics*
- (2) *traveler\_route\_list*
  - (3) *route\_segment\_description*
  - (3) *route\_segment\_end\_point*
  - (3) *route\_segment\_estimated\_arrival\_time*
  - (3) *route\_segment\_estimated\_condition*
  - (3) *route\_segment\_mode*
  - (3) *route\_segment\_predicted\_weather*
  - (3) *route\_segment\_report\_position\_points\_list*
  - (3) *route\_segment\_start\_point*

- (1) *traveler\_total\_trip\_cost*
- This data item contains the total cost of a traveler's trip. This will be a trip that has been previously confirmed by the traveler from either a personal device or a kiosk, and for which where necessary, reservations have been made.

#### **Physical Architecture Flow: yellow pages information**

**W,UIt**

Travel service information covering tourist attractions, lodging, restaurants, service stations, emergency services, and other services and businesses of interest to the traveler.

#### **Leveled Data Items:**

- (1) *traveler\_personal\_yellow\_pages\_data*
- This data item contains details of other (yellow pages) services which is to be sent to the traveler personal interface facility.
- (2) *traveler\_identity*
  - (2) *yellow\_pages\_general\_information*
    - (3) *yellow\_pages\_history*

- (3) *yellow\_pages\_local\_customs*
- (3) *yellow\_pages\_people*
- (3) *yellow\_pages\_specific\_information*
  - (3) *yellow\_pages\_food*
  - (3) *yellow\_pages\_gas\_stations*
  - (3) *yellow\_pages\_hospitals*
  - (3) *yellow\_pages\_lodging*
  - (3) *yellow\_pages\_parking*
  - (3) *yellow\_pages\_private\_vehicle\_parts\_shops*
  - (3) *yellow\_pages\_private\_vehicle\_repair\_shops*
  - (3) *yellow\_pages\_rest\_areas*
  - (3) *yellow\_pages\_special\_events*
  - (3) *yellow\_pages\_tourist\_activities*
  - (3) *yellow\_pages\_tourist\_services*
- (2) *yellow\_pages\_transaction\_information*
  - (3) *yellow\_pages\_dining\_information*
  - (3) *yellow\_pages\_lodging\_reservations*
  - (3) *yellow\_pages\_ticket\_information*

#### **4.4. Information Service Provider -> Vehicle**

##### **Physical Architecture Flow: broadcast information**

U1b

General broadcast information that contains link travel times, incidents, advisories, transit services and a myriad of other traveler information.

##### **Leveled Data Items:**

###### **(1) *area\_air\_quality\_index***

This data item contains a code for the area wide air quality level.

###### **(1) *incident\_data***

This data item contains current incident information.

###### **(2) *incident\_description***

###### **(2) *incident\_duration***

###### **(2) *incident\_location***

###### **(2) *incident\_number***

###### **(2) *incident\_severity***

###### **(2) *incident\_start\_time***

###### **(2) *incident\_traffic\_impact***

###### **(2) *incident\_type***

(2) *incident\_vehicles\_involved*

(1) *link\_state\_data\_for\_broadcast*

This data item contains speed and occupancy on each link within the road (surface street) and highway network in the geographic area relevant to the user.

(2) *link\_delay*

(2) *link\_list*

(2) *link\_travel\_time*

(2) *vehicle\_occupancy*

(2) *vehicle\_speed*

(1) *parking\_lot\_storage\_data\_list*

This data item contains a list of occupancy and state data for one or more parking lots in a local geographic area.

(2) *parking\_lot\_current\_occupancy*

(3) *parking\_lot\_calculated\_occupancy*

(3) *parking\_lot\_identity*

(2) *parking\_lot\_identity*

(2) *parking\_lot\_state*

(1) *planned\_events\_for\_broadcast*

This data item contains data about planned events for use in wide area broadcast messages that are automatically output to drivers and travelers in vehicles.

(2) *incident\_description*

(2) *incident\_location*

(2) *incident\_severity*

(2) *incident\_traffic\_impact*

(2) *incident\_type*

(1) *predicted\_highway\_network\_data*

This data item contains data about predicted traffic conditions on links in the highway network served by the function.

(2) *link\_delay*

(2) *link\_list\_for\_highways*

(2) *link\_occupancy*

(2) *link\_speed*

(2) *link\_travel\_time*

(1) *roadway\_environment\_conditions*

This data item contains processed environment sensor information which provides a summary of environment conditions referenced to a link.

(2) *link\_environment\_conditions*

(2) *link\_list\_identities*

(1) *source\_identity*

This data item defines the logical identifier of a source of information.

(1) *transit\_running\_data\_for\_broadcast*

This data item contains data on the current state of transit operations for use in driver and transit user wide area broadcast messages. The messages will only contain data that is unusual, e.g. service suspension, temporary revised timings, etc..

(2) *transit\_route\_number*

(2) *transit\_route\_segment\_number*

(2) *transit\_stop\_scheduled\_time*

(2) *transit\_vehicle\_achieved\_time*

(2) *transit\_vehicle\_identity*

(2) *transit\_vehicle\_time*

(1) *transit\_services\_for\_broadcast*

This data item provides details of transit services to a driver or transit user as part of a wide area broadcast message. This message will only contain data that is unusual such as a new service, new route, closure of an existing service, etc.

**Physical Architecture Flow: traveler information**

**U1t,U1b**

Traveler information comprised of traffic status, advisories, incidents, payment information and many other travel-related data updates and confirmations.

**Leveled Data Items:**

(1) *advanced\_tolls\_and\_fares\_response*

This data item contains the result of the requested advanced toll and/or transit fare payment transaction from a driver.

(2) *confirmation\_flag*

(2) *credit\_identity*

(2) *parking\_lot\_cost*

(2) *stored\_credit*

(2) *toll\_cost*

(2) *transit\_fare*

(1) *driver\_map\_update\_payment\_response*

This data item contains the response to a previous request from the driver that payment be made for an update of the navigable map database used for on-line vehicle guidance.

(2) *confirmation\_flag*

(2) *credit\_identity*

(2) *vehicle\_identity*

(1) *link\_performance\_data*

This data item contains speed and occupancy on each link within the road (surface street) and highway



network in the geographic area relevant to the user.

(2) *link\_delay*

(2) *link\_list*

(2) *link\_travel\_time*

(2) *vehicle\_occupancy*

(2) *vehicle\_speed*

(1) *parking\_lot\_current\_state*

This data item contains the identity of the parking lot plus its current status and occupancy.

(2) *parking\_lot\_current\_occupancy*

(3) *parking\_lot\_calculated\_occupancy*

(3) *parking\_lot\_identity*

(2) *parking\_lot\_identity\_list*

(2) *parking\_lot\_state*

(1) *planned\_events\_for\_advisories*

This data item contains data about planned events for use in advisory messages that are requested by and output to drivers and transit users in vehicles. The data will be restricted to those events which impact the local road and highway network.

(2) *incident\_description*

(2) *incident\_location*

(2) *incident\_severity*

(2) *incident\_traffic\_impact*

(2) *incident\_type*

(1) *pollution\_advisory\_data*

This data item contains advisory data about area and roadside pollution levels.

(2) *pollution\_state\_area\_collection*

(3) *area\_air\_quality\_index*

(3) *current\_pollution\_data*

(3) *current\_pollution\_location*

(2) *pollution\_state\_roadside\_collection*

(3) *current\_pollution\_data*

(3) *current\_roadside\_pollution\_location*

(1) *prediction\_data\_for\_advisories*

This data item is used to provide advisory messages to drivers and transit users in vehicles showing predictions of traffic data for route segments on the road and highway network served by the Manage Traffic function. Data will only be provided where it is relevant to the current location of the vehicle from which the request originated.

(2) *route\_segment\_journey\_time*

(2) *route\_segment\_occupancy\_predictions*

(2) *route\_segment\_queue\_delay\_predictions*

(2) *route\_segment\_volume\_delay\_predictions*

(1) *transit\_running\_data\_for\_advisories*

This data item contains data on the current state of transit operations for use in driver and transit user advisory output messages. The messages will only contain data that is relevant to the vehicle's current location.

(2) *transit\_route\_number*

(2) *transit\_route\_segment\_number*

(2) *transit\_stop\_scheduled\_time*

(2) *transit\_vehicle\_achieved\_time*

(2) *transit\_vehicle\_identity*

(2) *transit\_vehicle\_time*

(1) *transit\_services\_for\_advisories*

This data item provides details of transit services that are relevant to a driver or transit user who is requesting advisory information from a vehicle.

**Physical Architecture Flow: trip plan**

**U1t**

A sequence of links and special instructions comprised of a trip plan indicating efficient routes for navigating the links. Normally coordinated with traffic conditions, other incidents, preemption and prioritization plans.

**Leveled Data Items:**

(1) *vehicle\_guidance\_route*

This data item contains a subset of the data items included in the route data item to meet the requirements of in-vehicle infrastructure based guidance as opposed to the more general requirements for a route need as part of a trip planning activity. This data item includes the information required to provide an initial route or a route change while enroute.

(2) *route\_identity*

(2) *route\_segment\_description*

(2) *route\_segment\_end\_point*

(2) *route\_segment\_estimated\_travel\_time*

(2) *route\_segment\_report\_position\_points*

(2) *route\_segment\_start\_point*

(2) *vehicle\_identity*

**Physical Architecture Flow: yellow pages information**

**U1t**

Travel service information covering tourist attractions, lodging, restaurants, service stations, emergency services, and other services and businesses of interest to the traveler.

**Leveled Data Items:**

(1) *yellow\_pages\_advisory\_data*

This data item provides yellow pages data to drivers and transit users in vehicles and/or confirmation of a previously requested reservation.

(2) *yellow\_pages\_dining\_reservation\_confirmation*  
(2) *yellow\_pages\_lodging\_reservation\_confirmation*  
(2) *yellow\_pages\_service\_contact*  
(2) *yellow\_pages\_service\_cost*  
(2) *yellow\_pages\_service\_date*  
(2) *yellow\_pages\_service\_description*  
(2) *yellow\_pages\_service\_location*  
(2) *yellow\_pages\_service\_time*  
(2) *yellow\_pages\_service\_type*  
    (3) *yellow\_pages\_food*  
    (3) *yellow\_pages\_gas\_stations*  
    (3) *yellow\_pages\_history*  
    (3) *yellow\_pages\_hospitals*  
    (3) *yellow\_pages\_lodging*  
    (3) *yellow\_pages\_parking*  
    (3) *yellow\_pages\_people*  
    (3) *yellow\_pages\_private\_vehicle\_parts\_shops*  
    (3) *yellow\_pages\_private\_vehicle\_repair\_shops*  
    (3) *yellow\_pages\_rest\_areas*  
    (3) *yellow\_pages\_special\_events*  
    (3) *yellow\_pages\_tourist\_activities*  
    (3) *yellow\_pages\_tourist\_services*  
(2) *yellow\_pages\_ticket\_purchase\_confirmation*

## 5. Communications Considerations

This chapter describes relevant requirements and information regarding the portion of the Communications Layer of the ITS National Architecture covered by this package. In general the Communications Layer supports the four lower layers of the OSI model (transport, network, data link and physical layer). A complete description of the Communications Layer is contained in the ITS National Architecture Communications Analysis Document.

### 5.1 Communications Services: Wireline and Wireless

The communication services define the exchange of information between two points and are independent of media and application (i.e., ITS user service). In essence, they are a specified set of user-information transfer capabilities provided by the communication layer to a user in the transportation layer.

Communication services consist of two broad categories, *interactive* and *distribution*. Interactive services allow the user to exchange data with other users or providers in real or near real time, asking for service or information and receiving it in the time it takes to communicate or look up the information. Distribution services allow the user to send the same message to multiple other users.

Interactive services may be either *conversational* or *messaging*. Conversational implies the use of a two-way connection established before information exchange begins and terminated when the exchange is completed. Messaging, on the other hand, works more like electronic mail being exchanged between users. The messages are exchanged without establishing a dedicated path between the two sites. Each message is addressed and placed on the network for transmission, intermixed with messages from other users. The communications community labels this mode of communication a “datagram” service.

Distribution services may be either *broadcast* or *multicast* and may be used over wireline and/or wireless communication links. Broadcast messages are those sent to all users while multicast messages are sent only to a subset of users. Multicast differs from broadcast in its use of a designated address for all users and user groups. Examples of broadcast information might include current weather or road conditions, whereas multicast information might be information sent to all drivers working for a specific company. A changing group membership could be the set of users traveling between two locations or with a certain destination, for which unique information must be transmitted. The services that can be supported using circuit or packet connection mode include voice, video, image and data. (see Appendix A-1 of the communication document for a complete description.)

An additional class of communications services is location services. These fall in two categories: (1) the services that do not use the communication network (i.e., GPS, and stand alone terrestrial systems); (2) location services that use the network for providing the service (e.g., cellular based systems). In the latter case, the location services fall under the interactive services. The service will be rendered by a service provider in response to a request for information or help.

The class of communications service for each Architecture Flow in this standards package is defined in a table in the following section.

### 5.2. Wireline Communication Elements (w)

There are no wireline interfaces in this standards requirements package

### **5.3. Wireless Communication Elements (u1 and u2)**

Given the ITS goal of seamless nationwide wireless services, the following three requirements can be stated for any wireless wide area network (WAN) communication elements:

1. The interfaces use open standards.

[This guarantees that ITS subsystem equipment from many competing manufacturers can be used to connect using the communications element. The cost of the data communication module (e.g., modem, transceiver) should be small relative to the ITS subsystem.]

2. The communication element be internetworked with other communication elements.

[The communication element provider must participate in the open internetworking standards that enable messaging between users of different communication element technologies.]

3. The communication element be nearly ubiquitous to the nation or at least a region.

[This enables users to “roam” over a substantial area of user interest and have seamless access to ITS services. The roaming capability is supported by the communication service provider.]

Exceptions will be found for specific deployments where legacy communication systems need to be accommodated, or where some of the interoperability related benefits of ITS are not important (e.g. dedicated regional safety or transit services). It is expected in these cases that the capability to interface to open systems (through the wireline networks) to allow information exchange will still be possible.

The rest of this chapter is a discussion of how the WAN wireless communication elements will function within the architecture and is informational rather than requirements based.

The WAN wireless communication element can be dedicated to a specific user or agency (and publicly owned or privately owned), or it can be privately owned and operated by a communication service provider who sells access to this data network to many users or agencies for a fee.

A key feature of most wireless communication elements is that they are or can be internetworked to a wireline communication system of some sort. In this way, mobile units can exchange ITS messages with Center or Roadside subsystems. We assume and require that the 2-way ITS wireless communication network will have the necessary coverage for a particular user service application, and that the wireless network will be internetworked to the wireline wide area communications network. The following sections discuss various options that might be deployed.

Wireless communication systems can be one-way (broadcast) or two-way. For broadcast systems, an example is FM-subcarrier systems. Two-way systems that are private can be SMR (Special Mobile Radio) or E-SMR (Enhanced SMR). SMR and E-SMR require licenses from the FCC for operation, and are typically dedicated to a specific service or agency.

### **Dedicated and Shared Communications**

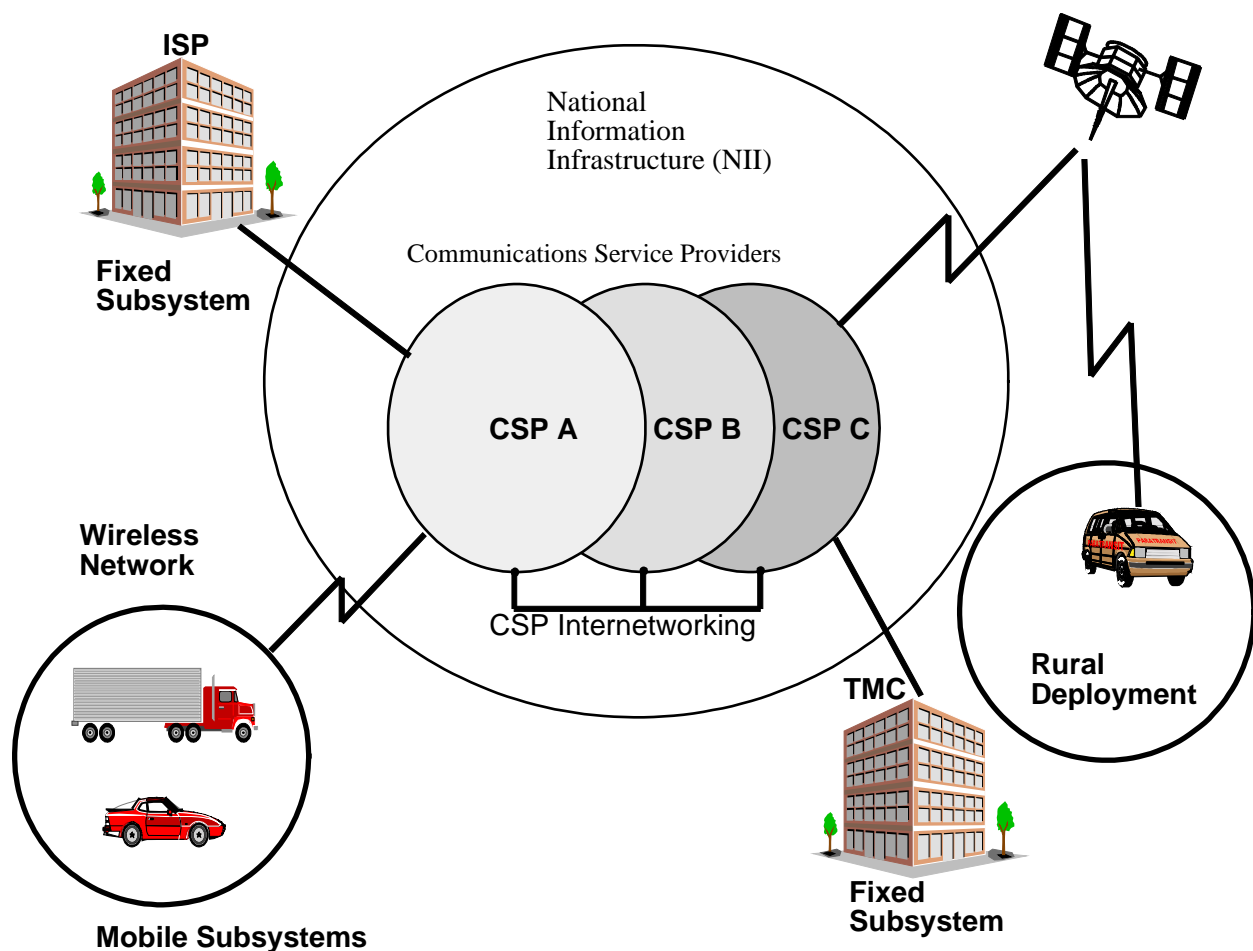
We think it likely that in the 20-year timeframe, Wide Area Network (WAN) data communications will have become largely a commodity with many competing suppliers of wireline and 2-way wireless services. As a commodity, the ITS Subsystems will use whatever WAN communication service is available that meets the operators needs at the lowest price.

Today, since the commoditization of WAN 2-way data communications is still in its early stages, many ITS early deployments and Field Operational Tests (FOTs) properly use dedicated WAN systems or one-way FM-subcarrier and pager systems. The architecture supports both private and shared deployments as appropriate.

## Architecture Robustness to Spatially Different Deployments

This section discusses how different deployments (Urban, Interurban and Rural) of the architecture will interoperate giving specific focus on the strategy for mobile subsystems.

Figure 13 shows how a large number of Communication Service Providers (CSPs) both internetwork themselves together and connect to their clients, thus provide any-to-any messaging for their clients to and from any other clients on the set of internetworked CSPs. This is, at a very high level, how the Internet functions today, and how the NII will function in the future.



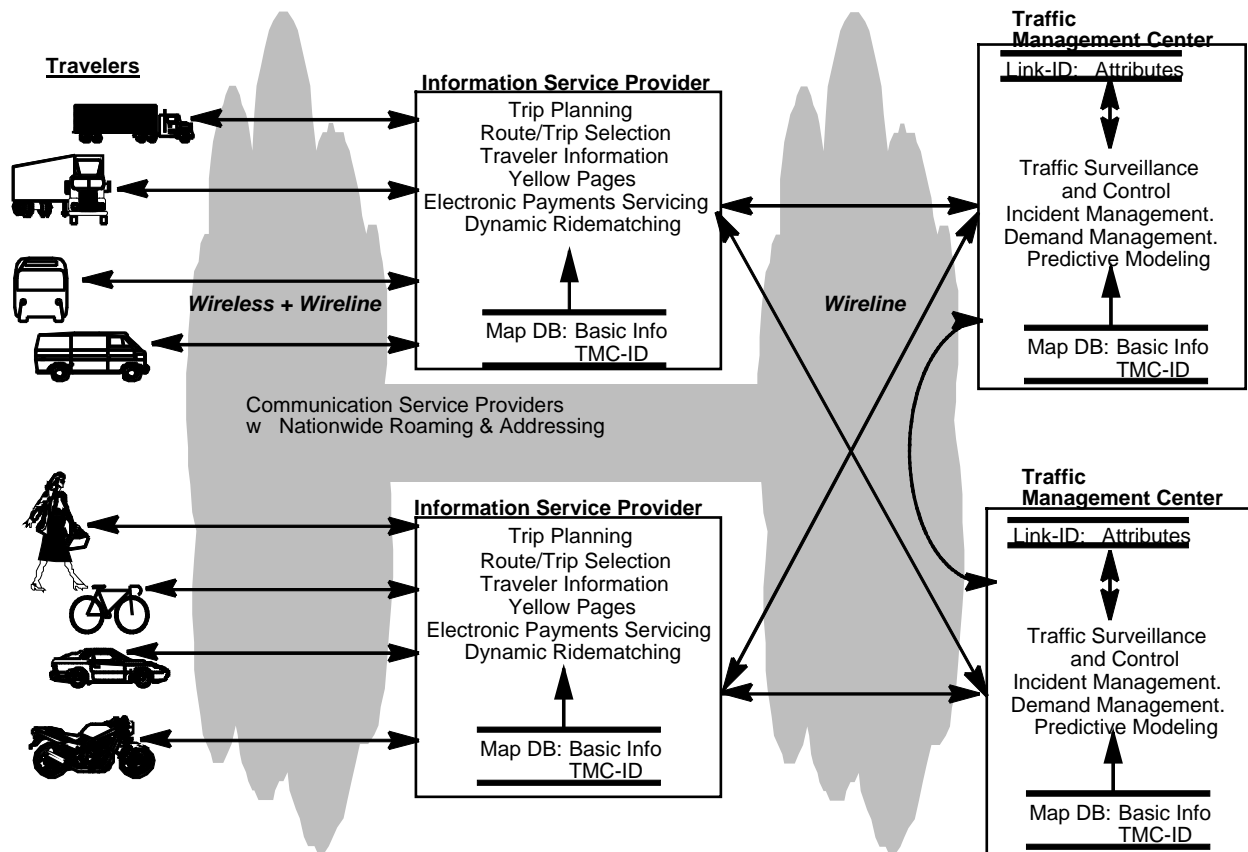
**Figure 13 - ITS Communications Network Topology**

The key feature of this system is that the clients can connect to their chosen CSP with any technology, wireline or wireless, and send messages to any other client of any other CSP, independent of the technology that they have chosen to connect with.

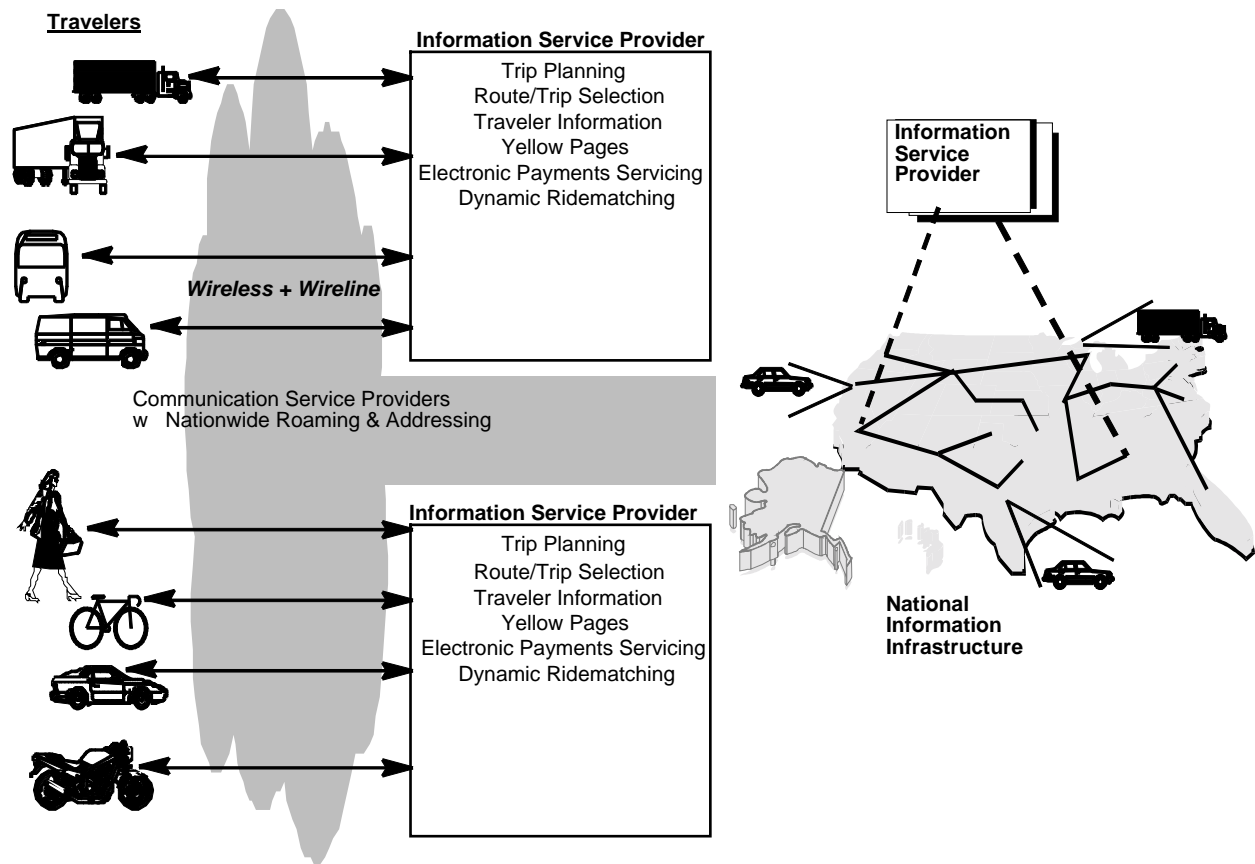
Mobile clients will be able to “roam”, that is move geographically anywhere that their service provider offers service, and be able at any time to send or receive data messages. This capability already exists for the Advanced Mobile Phone System (AMPS), and will be extended for the emerging data services based on the same cell-based communication technologies. Mobile data service providers can be expected to make arrangements with providers out of their area to reciprocally give their clients roaming privileges outside of their “home” areas, thus extending mobile connectivity across the country.

Institutionally, the clients have a choice of CSPs to choose from. Competition for clients will result in aggressive pricing and technology deployments by the CSPs, leading the commoditization of wireline and wireless communications referred to earlier.

Figure 14 shows that ISPs use wireline and wireless communications to provide services to their clients (including Transit Vehicles and Emergency Vehicles for Publicly operated ISPs). Figure 15 combines the previous discussion regarding Communication Service Providers, internetworked to effect the NII, and the connection to an ISP, to show how a client can choose an ISP and be in communications with the selected ISP no matter where they are in the country. At the same time, the ISP is using the NII to access TMCs across the country to service the requests of the client.



**Figure 14 - Open National Compatibility**



**Figure 15 - Traveler to ISP National Interoperability**



## 6. Constraints

This chapter identifies Physical Architecture intersubsystem message performance requirements below the application layer.

### 6.1 Assessment Categories

The following categories have been used in rating the constraints that exist on the physical data flows.

#### 1. Performance

##### a. Emergency Priority (E)

Essentially "real-time" requirements. Emergency data that is time critical must be received by a certain absolute time, or it is useless. For these flows the communication channel may require priority in emergencies. The data channels require must be operational even when there is an emergency which might place other loads on the interface. A private communication channel or frequency may be required to satisfy the requirement.

##### b. Reliability(R)

This category encompasses both the concepts of reliability and availability. Data must be delivered reliably. Loss can not be tolerated. The communications link must also have high availability. Failure of the communication medium may result in severe accident. This communication channel may require redundant paths or extra attention paid to potential failure modes. For wireline cases, this may indicate alternate phone or other connections are required. For wireless cases (e.g. for AHS applications), special attention will be paid to the transmitters, receivers, and potential interference for these connections.

##### c. Timing (T)

The timing constraints are critical. If communication does not occur within set limits system failures can occur. Timing for most ITS communication services is based on the response to a request for data. Because of this, common communication media designed to handle voice data will likely support these requirements. The beacon interface has special requirements of identifying the vehicle as well as exchanging information before the vehicle gets out of range. This is more of a problem with vehicles travelling at speed. The architecture constrains such time critical access to data such that the data is available at the beacon site. This obviates the need for explicit specification of other timing information to support data transfer over a short range beacon.

This timing constraint is related to (but not the same as) another attribute often discussed in specifying systems: latency. Latency is used to quantify end-to-end processing and transmission time (round trip delays). Data with a latency requirement must be handled within a certain time interval. This differs from "time criticality" in that it is a relative rather than absolute time requirement (i.e. latency: interface screen must update every 2 seconds; time criticality: route instructions must be received 30 seconds prior to first turning action). Because latency requirements are greatly affected by the implementation of the subsystem elements, it can not be specified directly when discussing only the interface between two subsystems.

## 2. Data Sensitivity

### a. Security (S)

Access to the data must be restricted. Data itself must be secure during transmission. This is typically used for financial information.

### b. Privacy(P)

Anonymity of the data source or recipient must be protected. This is typically used for personal information.

## 6.2 Architecture Flow Constraints

**Table 2 - Architecture Flow Constraints**

Source	Destination	Architecture Flow	Interconnects	Communication Service	Special Constraints
Information Service Provider	Personal Information Access	traveler information	W,U1t	Broadcast data, Multicast data	P
Information Service Provider	Personal Information Access	trip plan	W,U1t	Conversational data, Messaging data	P
Information Service Provider	Vehicle	traveler information	U1t,U1b	Messaging data, Broadcast data, Multicast	P
Information Service Provider	Vehicle	trip plan	U1t	Conversational data, Messaging data	P
Personal Information Access	Information Service Provider	traveler profile	W,U1t	Conversational data, Messaging data	P
Personal Information Access	Information Service Provider	traveler request	W,U1t	Conversational data, Messaging data	P
Personal Information Access	Information Service Provider	trip confirmation	W,U1t	Conversational Data, Messaging data	P
Personal Information Access	Information Service Provider	trip request	W,U1t	Conversational Data, Messaging data	P
Personal Information Access	Information Service Provider	yellow pages request	W,U1t	Conversational Data, Messaging data	P
Vehicle	Information Service Provider	traveler profile	U1t	Conversational data, Messaging data	P
Vehicle	Information Service Provider	traveler request	U1t	Conversational data, Messaging data	P
Vehicle	Information Service Provider	trip confirmation	U1t	Conversational data, Messaging data	P
Vehicle	Information Service Provider	trip request	U1t	Conversational data, Messaging data	P
Vehicle	Information Service Provider	vehicle probe data	U1t	Messaging data, location data	P
Vehicle	Information Service Provider	yellow pages request	U1t	Conversational data, Messaging data	P

## 7. Leveled Data Items

This section contains the leveled data item (LDI) definitions for all the leveled data item elements listed in this standards requirements package.

The LDIs are given in alphabetical order.

### **advanced\_fare\_details**

This data item contains details of the transit ride for which a driver wishes to make an advanced payment.

### **advanced\_fares\_confirm**

This data item shows that payment for advanced transit fares has been confirmed or not.

### **advanced\_parking\_lot\_charges**

This data item contains data to enable an advanced parking lot charge to be calculated and billed.

### **advanced\_tolls**

This data item contains data to enable an advanced toll to be calculated and billed.

### **advanced\_tolls\_and\_fares\_response**

This data item contains the result of the requested advanced toll and/or transit fare payment transaction from a driver.

### **advanced\_tolls\_confirm**

This data item shows whether the payment for an advanced toll has been confirmed or not.

### **advisory\_data\_request**

This data item is used to request that advisory data be output to a driver or a traveler in a vehicle. The scope and transit route number data will be provided by the driver or transit user, while the vehicle location will be provided automatically.

### **advisory\_data\_scope**

This data item shows the scope of the advisory data requested by the driver or transit user from a vehicle. It can be used to characterize the type of traffic, transit, or yellow pages data requested.

### **area\_air\_quality\_index**

This data item contains a code for the area wide air quality level.

### **confirmation\_flag**

This data item indicates the success or failure of a request or transaction.

### **constraint\_on\_acceptable\_travel\_time**

This data item contains the maximum total travel time which the traveler or driver will allow for the selected route.

### **constraint\_on\_ahs\_lanes**

This data item indicates whether the route can include automated highway segments.

### **constraint\_on\_eta\_change**

This data item contains the value by which the estimated time of arrival (ETA) at the destination must change for a new route to be automatically sent to the vehicle, or used for autonomous guidance with long journey and queue times being obtained from a central source.

### **constraint\_on\_interstate**

This data item indicates whether interstate freeways are not acceptable, acceptable, or preferred in a route.

### **constraint\_on\_load\_classification**

This data item specifies the load type. This is principally aimed at hazardous material (HAZMAT) type loads that may require special routing restrictions.

### **constraint\_on\_number\_of\_mode\_changes**

This data item contains the maximum number of changes between different modes of transport

which the traveler or driver wishes to see used in the planned trip.

**constraint\_on\_number\_of\_transfers**

This data item contains the maximum number of mode changes that a traveler or driver will allow when a multimodal route is being specified.

**constraint\_on\_special\_needs**

This data item covers physical and/or mental disabilities which may affect the choice of mode, route, etc., e.g. blind and will be accompanied, blind with a guide dog, deaf, mute, uses crutches, wheelchair bound, etc.

**constraint\_on\_urban**

This data item contains a flag which if set to one (1) means avoid all urban roads except for when they are needed for access.

**constraint\_on\_vehicle\_type**

This data item specifies the route suitable for a particular type or types of vehicle.

**constraints**

This data item contains the constraints being placed on the choice of route and which will override any preferences that are also specified. Unless a default value is specifically defined, a value giving the least severe requirement will be used. Some parameters will have to be supplied by the traveler or driver (or provided by a process as a default value) before the route selection process can proceed.

**credit\_identity**

This data item contains the identity number of a credit card which is to be used to secure preclearance from paying dues, taxes, and other commercial vehicles charges, or by a traveler or driver for payment of current or advanced tolls, fares, parking lot charges, or for yellow pages services.

**current\_conditions**

This data item contains data about current incidents and weather conditions relevant to the traveler's personal trip.

**current\_highway\_network\_data**

This data item contains data about traffic conditions on links in the highway network.

**current\_pollution\_data**

This data item contains the current pollution data detected. The pollution data includes ozone pollution, nitrous oxide pollution, sulfur dioxide pollution, hydrocarbon pollution, carbon monoxide pollution, particulate pollution, and roadside pollution.

**current\_pollution\_location**

This data item gives the location coordinates from which a set of current pollution levels have been obtained.

**current\_road\_network\_data**

This data item contains data about traffic conditions on links in the road network served by the function. This data is used for determining traffic management strategies and is also sent for storage in both the long term and current data stores.

**current\_roadside\_pollution\_location**

This data item contains the location at which an associated set of current roadside atmospheric pollution values have been obtained from sensors.

**current\_weather\_from\_weather\_service**

This data item contains details of the current weather conditions, e.g. temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.

**departure\_time**

This data item defines the time at which a driver or traveler's planned or requested trip is to start.

**desired\_arrival\_time**

This data item specifies the target time for arrival at the end of a driver or traveler's planned or

requested trip.

**destination**

This data item defines the destination point for a trip request or a route to be used by a traveler or a vehicle.

**display\_map\_traveler\_update\_cost**

This data item contains the cost (cents) of an update to the digitized map data used as the background to displays of traffic and travel information on a traveler's personal device.

**driver\_map\_update\_payment\_request**

This data item contains a request that payment be made for an update of the navigable map database used for on-line vehicle guidance. The payment will be made by debiting the credit identity with the cost through the financial institution terminator.

**driver\_map\_update\_payment\_response**

This data item contains the response to a previous request from the driver that payment be made for an update of the navigable map database used for on-line vehicle guidance.

**incident\_data**

This data item contains current incident information.

**incident\_description**

This data item contains the description and other free form information associated with an incident.

**incident\_duration**

This data item contains the expected duration of an incident from its start time until the time at which it is expected that it will have no further effect on traffic conditions.

**incident\_location**

This data item contains the location at which an incident will take place (for planned events) or is taking place (for current incidents).

**incident\_number**

This data item identifies a specific incident.

**incident\_severity**

This data item identifies the severity of an incident.

**incident\_start\_time**

This data item contains the incident start time.

**incident\_traffic\_impact**

This data item contains details of the impact that a particular incident will have on traffic flows.

**incident\_type**

This data item uniquely defines the type of incident.

**incident\_vehicles\_involved**

This data item defines the number of vehicles involved in an incident at the time of the report.

**link\_delay**

This data item contains the calculated delay for vehicles driving along a particular link in the road and highway network served by the function.

**link\_environment\_conditions**

This data item contains environment conditions (e.g. rain, wind, sun, etc) computed for a single link .

**link\_identity\_list**

This data item contains a list of the links in the road and freeway network that are covered by a transit route segment. The data may contain up to four (4) links to be part of a segment in all three scenarios (urban, inter-urban and rural).

**link\_list**

This data item contains a list of links for which data is being provided.

**link\_list\_for\_highways**

This data item contains a list of links for which data is being provided. These links will comprise all

of those on the highway network served by the function.

**link\_list\_for\_roads**

This data item contains a list of links for which data is being provided.

**link\_list\_identities**

This data item contains a list of links for which data is being provided. These links will comprise all of those on both the road (surface street) and highway network served by the function. It contains the unique identity of each link, which is a short segment typically less than one mile, e.g. a segment of freeway between off-ramps or a street segment between two intersections.

**link\_occupancy**

This data item contains predictions of the occupancy for route segments on the road and highway network served by the Manage Traffic function.

**link\_performance\_data**

This data item contains speed and occupancy on each link within the road (surface street) and highway network in the geographic area relevant to the user.

**link\_speed**

This data item contains the calculated average speed of vehicles traveling on the link.

**link\_state\_data\_for\_broadcast**

This data item contains speed and occupancy on each link within the road (surface street) and highway network in the geographic area relevant to the user.

**link\_travel\_time**

This data item contains the current journey time for vehicles on a particular link.

**location\_identity**

This data item contains the location of any transportation feature, entity, or event in an unambiguous and mutually understandable way.

**modes**

This data item forms part of the data used for route requests and trip plans. It defines the mode(s) of transport to be used on a requested route or proposed trip.

**navigable\_map\_traveler\_update\_cost**

This data item contains the cost of an update to the navigable map database used for on-line traveler guidance.

**navigable\_map\_vehicle\_update\_cost**

This data item contains the cost of an update to the digitized map data used for on-line vehicle guidance.

**origin**

This data item defines the origin point for a trip request or a route to be used by a traveler or a vehicle.

**paratransit\_personal\_schedule**

This data item provides a personalized paratransit schedule specifying an itinerary and cost.

**paratransit\_service\_confirmation**

This data item confirms that the traveler wants to use the previously identified paratransit service.

**paratransit\_service\_identity**

This data item provides a unique identity number for a requested paratransit service.

**parking\_lot\_calculated\_occupancy**

This data item contains the current occupancy of a parking lot, i.e. the number of vehicles present, calculated from traffic sensors located at its entrance(s) and exit(s).

**parking\_lot\_cost**

This data item defines the cost of particular vehicle using a space in a parking lot for a particular time period.

**parking\_lot\_current\_occupancy**

This data item contains the parking lot identity and current occupancy.

**parking\_lot\_current\_state**

This data item contains the identity of the parking lot plus its current status and occupancy.

**parking\_lot\_identity**

This data item contains the identity of an individual parking lot so that its charges can be defined and a control strategy applied to its use.

**parking\_lot\_identity\_list**

This data item contains a list of parking lots to which a particular strategy is to be applied. The strategy will either promote or discourage the use of the parking lots to generally improve traffic flow conditions in the geographic area controlled by the TMC.

**parking\_lot\_occupancy**

This data item contains the current occupancy of a parking lot, i.e. the number of vehicles present.

**parking\_lot\_state**

This data item contains the current state of a parking lot. It indicates whether the parking lot is open and has spaces available.

**parking\_lot\_storage\_data\_list**

This data item contains a list of occupancy and state data for one or more parking lots in a local geographic area.

**parking\_space\_requirements**

This data item specifies the time, location, and specific parking space requirements for a particular user.

**planned\_events\_for\_advisories**

This data item contains data about planned events for use in advisory messages that are requested by and output to drivers and transit users in vehicles. The data will be restricted to those events which impact the local road and highway network.

**planned\_events\_for\_broadcast**

This data item contains data about planned events for use in wide area broadcast messages that are automatically output to drivers and travelers in vehicles.

**pollution\_advisory\_data**

This data item contains advisory data about area and roadside pollution levels.

**pollution\_state\_area\_collection**

This data item contains the current states of the various types of pollution within the atmosphere in the geographic area served by the function. It also contains a summary indication of the area air quality.

**pollution\_state\_roadside\_collection**

This data item contains the digitized values of pollution levels obtained from roadside sensors in the geographic area served by the function.

**predicted\_highway\_network\_data**

This data item contains data about predicted traffic conditions on links in the highway network served by the function.

**predicted\_parking\_lot\_data**

This data item contains predicted parking lot states produced by the predictive model process.

**predicted\_road\_network\_data**

This data item contains data about predicted traffic conditions on links in the road network served by the function.

**predicted\_weather\_from\_weather\_service**

This data item contains details of the predicted weather conditions, e.g. temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.

**prediction\_data\_for\_advisories**

This data item is used to provide advisory messages to drivers and transit users in vehicles showing predictions of traffic data for route segments on the road and highway network served by the Manage Traffic function. Data will only be provided where it is relevant to the current location of the vehicle from which the request originated.

**preferences**

This data item is part of the data needed to request a route involving automatic highway system (ahs) lanes. It contains the preferences being placed on the choice of a route being requested by a driver or traveler.

**preferred\_alternate\_routes**

This data item contains the number of alternate routes that are to be provided to the driver or traveler making the route request. These alternate routes will be in addition to the primary route, which will be the one that most nearly meets the specified preferences and constraints.

**preferred\_ridesharing\_options**

This data item contains preferred ridesharing options.

**preferred\_route\_segments**

This data item contains a list of preferred route segments.

**preferred\_routes**

This data item contains a list of waypoints or other preferred route information that constrains the selected route.

**preferred\_transit\_options**

This data item contains preferred transit options.

**preferred\_weather\_conditions**

This data item contains the preferred weather conditions on the road segment at the time which it will be used.

**reservation\_status**

This data item shows the status of a reservation that is being or has been requested. If the flag is set to true the reservation was accepted, but if set to false, then the reservation was denied.

**rideshare\_details**

This data item contains a list of potential ridesharing matches. This data will provide information on the other participants in the proposed rideshare, pick-up and drop-off points, etc.

**rideshare\_response**

This data item provides the response to travelers' rideshare request.

**rideshare\_selection\_number**

This data item provides the identification number for a rideshare selection that has been made in response to a traveler's request.

**roadway\_environment\_conditions**

This data item contains processed environment sensor information which provides a summary of environment conditions referenced to a link.

**route\_cost**

This data item contains the cost of using a particular route. This is made up of some or all of such things as tolls, fares, port charges, plus the cost of commercial vehicle credential filing and tax payments.

**route\_identity**

This data item contains the identity of a route that is to be used for either on-line vehicle or traveler guidance. The data is for internal use within the function and identifies the route when the driver or traveler subsequently accepts it for use.

**route\_segment\_description**

This data item contains a description of the physical details for the entire route segment. This data is used to provide information from which guidance can be produced in a form which is understandable



by the driver, e.g. lane selection, right/left turns, etc.

**route\_segment\_end\_point**

This data item contains the location of the end of a route segment.

**route\_segment\_estimated\_arrival\_time**

This data item contains the estimated time at which the route segment end point will be reached.

**route\_segment\_estimated\_condition**

This data item contains the traffic conditions expected on the route segment at the time at which it will be used.

**route\_segment\_estimated\_travel\_time**

This data item contains the estimated time it will take a vehicle to travel the route segment taking account of the expected conditions defined in other data.

**route\_segment\_identity**

This data item identifies a route segment by name, location, or other standard location reference.

**route\_segment\_journey\_time**

This data item contains the average route segment journey time calculated from data being provided by guided vehicles.

**route\_segment\_mode**

This data item contains the mode that has been selected for use within the route segment. The choice of mode is made as part of the trip planning process. Only one mode can be used in any single route segment.

**route\_segment\_occupancy\_predictions**

This data item contains output from the predictive model process showing predictions of the occupancy for route segments on the road and highway network served by the Manage Traffic function.

**route\_segment\_predicted\_weather**

This data item contains the weather conditions expected on the road segment at the time at which it will be used.

**route\_segment\_queue\_delay\_predictions**

This data item contains output from the predictive model process showing predictions of the delay(s) due to traffic queues for route segments on the road and highway network.

**route\_segment\_report\_position\_points**

This data item contains a list of any points other than those at the route segment start and end where the vehicle's position is to be reported.

**route\_segment\_report\_position\_points\_list**

This data item contains a list of any points other than those at the route segment start and end where the vehicle's position is to be reported.

**route\_segment\_start\_point**

This data item contains the location of the start of a route segment.

**route\_segment\_volume\_delay\_predictions**

This data item contains output from the predictive model process showing predictions of the delay(s) due to traffic volume for route segments on the road and highway network. This delay is the additional time that a vehicle will take to move from the start of a route segment to its end, above that which it would need in free flow conditions.

**route\_start\_time\_date**

This data item contains the date and time at which a route will start taken from the time specified in the request for the route.

**route\_statistics**

This data item contains the overall predicted statistics associated with a route which may assist the traveler in making a final route selection. The statistics will include such things as itinerary,

estimated net travel time, time of arrival, total distance, anticipated delays/congestion, etc.

**source\_identity**

This data item defines the logical identifier of a source of information.

**stored\_credit**

This data item contains the value of the credit currently stored by the payment instrument.

**time**

This data item contains the current time of day and will be associated with other data items and (possibly) a date.

**toll\_cost**

This data item defines the cost of the toll for a particular vehicle through a toll plaza, thus giving it the ability to use the toll segment governed by the toll plaza.

**toll\_route\_segment\_list**

This data item contains a list of the identities of toll segments for which toll payment is being provided or requested. Toll segments occur in about the same frequency as the percentage of toll road miles to total freeway miles.

**traffic\_data\_for\_broadcast\_to\_personal\_devices**

This data item is used to provide broadcast data on the traffic flowing in the road network, plus that which is predicted to flow in the network for output to a traveler's personal device.

**traffic\_data\_personal\_request**

This data item contains the request for the provision of traffic data for output at a traveler's personal device.

**transit\_confirmation\_flag**

This data item indicates whether a paratransit service is to be used.

**transit\_deviations\_for\_broadcast\_to\_pers\_devices**

This data item contains current transit service deviations for a particular route to be broadcast to a traveler's personal device.

**transit\_deviations\_for\_personal\_devices**

This data item contains current transit service deviations for a particular route. This data will be output to a traveler's personal device.

**transit\_deviations\_personal\_request**

This data item is a request for data on current transit service deviations for output to a traveler's personal device. When a portable device is being used by the traveler. The request can be modified so that only the data for a transit route specified by the traveler from the portable device is requested.

**transit\_fare**

This data item contains the actual cost for the transit user to travel over a route in the transit network, i.e. the cost of going from a particular origin on a transit route to a particular destination on (possibly another) transit route.

**transit\_journey\_date**

This data item gives the date and time at which a transit journey is to be made by a traveler as a transit user and is used for trip planning purposes only.

**transit\_route\_destination**

This data item contains the destination of a transit route. The destination will be defined as the name of a transit stop

**transit\_route\_number**

This data item identifies a regular transit route.

**transit\_route\_origin**

This data item contains the origin of a transit route to be used by a traveler (advanced fares) or transit user. The origin will be defined as the name of a transit stop.

**transit\_route\_segment\_cost**

This data item contains the cost of the use of a particular transit route segment. It can only be used in association with the segment number, the category of the transit user and the time at which the route is used.

**transit\_route\_segment\_list**

This data item contains a list of the transit route segments that make up a particular transit route, plus the cost to a transit user for using each segment and the identity of the road or freeway link(s) over which the route segment runs.

**transit\_route\_segment\_number**

This data item identifies a transit route segment within the transit route on which it lies.

**transit\_running\_data\_for\_advisories**

This data item contains data on the current state of transit operations for use in driver and transit user advisory output messages. The messages will only contain data that is relevant to the vehicle's current location.

**transit\_running\_data\_for\_broadcast**

This data item contains data on the current state of transit operations for use in driver and transit user wide area broadcast messages. The messages will only contain data that is unusual, e.g. service suspension, temporary revised timings, etc..

**transit\_services\_for\_advisories**

This data item provides details of transit services that are relevant to a driver or transit user who is requesting advisory information from a vehicle.

**transit\_services\_for\_broadcast**

This data item provides details of transit services to a driver or transit user as part of a wide area broadcast message. This message will only contain data that is unusual such as a new service, new route, closure of an existing service, etc.

**transit\_stop\_scheduled\_time**

This data item contains the time at which a transit vehicle is scheduled to reach each stop on a transit route. This will thus be the scheduled time of arrival at the end of a transit route segment.

**transit\_vehicle\_achieved\_time**

This data item contains the time at which a transit vehicle actually reached the end of a transit route segment. This point is usually a transit stop and the data is thus the arrival time of a transit vehicle at each of the transit stop(s) along the transit route.

**transit\_vehicle\_deviation\_request**

This data item contains a request for the provision of data on the current transit service deviations for output to a traveler at a kiosk.

**transit\_vehicle\_identity**

This data item contains the identity of an individual transit vehicle. This data is used to identify the source and/or ownership of other data.

**transit\_vehicle\_schedule\_deviations\_list**

This data item contains a list of the deviations of transit vehicles from their published routes and schedules at transit route segments that have already been completed, i.e. at transit stops that have been passed by the vehicle. The data is used to provide information about the current state of the transit service operation to a traveler.

**transit\_vehicle\_time**

This data item contains the estimated time of arrival of a transit vehicle at the end of the next transit route segment not so far reached during its journey along the transit route.

**traveler\_contact\_setting**

This data item contains traveler's contact information to be used in his personal profile for obtaining travel information.

**traveler\_device\_setting**

This data item contains information about the device used by the traveler to access travel information. The data item contains a setting identity (so there can be multiple device settings per user), and specifics of the device which could include type of hardware, type of software, or modem speed and characteristics.

**traveler\_identity**

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

**traveler\_location**

This data item contains the traveler's location as computed from sensor data.

**traveler\_map\_update\_payment\_request**

This data item contains a request that payment be made for an update of the navigable map database used by the traveler for on-line personal guidance. The payment will be made by debiting the credit identity with the cost through the financial institution terminator.

**traveler\_map\_update\_payment\_response**

This data item contains the response to a previous request from the traveler that payment be made for an update of the navigable map database used for on-line traveler guidance.

**traveler\_personal\_current\_condition\_request**

This data item contains a request for details of the current conditions, e.g. weather, events, incidents, etc. The request includes the identity of the personal device from which the request was input by the traveler so that the response can be correctly returned.

**traveler\_personal\_display\_update\_payment\_request**

This data item contains a request that payment be made for an update of the digitized map data used as background to the displays of traffic and travel information on a traveler's personal device.

**traveler\_personal\_display\_update\_payment\_response**

This data item contains the response to a previous request from the traveler that payment be made for an update of the digitized map data used as background to the displays of traffic and travel information on a traveler's personal device.

**traveler\_personal\_payment\_confirmation**

This data item indicates the payment for a confirmed trip has been successfully completed, or that the total cost can now be deducted from the credit stored on the traveler's payment instrument.

**traveler\_personal\_transaction\_confirmation**

This data item confirms any reservations made by the traveler from a personal device. These reservations will be based on information obtained by the traveler from previous data input and output through the device.

**traveler\_personal\_transaction\_request**

This data item contains data input by the traveler at a personal device to make reservations for various other (yellow pages) services.

**traveler\_personal\_trip\_information**

This data item contains information about a proposed trip that the traveler has requested earlier from the personal device.

**traveler\_personal\_trip\_request**

This data item contains a request for personally tailored trip information.

**traveler\_personal\_yellow\_pages\_data**

This data item contains details of other (yellow pages) services which is to be sent to the traveler personal interface facility.

**traveler\_personal\_yellow\_pages\_information\_request**

This data item contains a request for data on other (yellow pages) services to be provided to a traveler using a personal device. The traveler identity is used as the means of ensuring that the data produced in response to the request is returned to the correct traveler. As no filtering components are

included, all the data currently available will be provided.

**traveler\_rideshare\_confirmation**

This data item contains a traveler's request to confirm a rideshare based trip.

**traveler\_rideshare\_constraints**

This data item is used to provide details of the constraints for a rideshare being requested as part of a traveler's proposed trip.

**traveler\_rideshare\_data**

This data item is used within the Provide Driver and Traveler Services function to provide details about a rideshare requested as part of a traveler's proposed trip.

**traveler\_rideshare\_preferences**

This data item is used to provide details of the preferences for a rideshare being requested as part of a traveler's proposed trip.

**traveler\_rideshare\_request**

This data item contains a request for rideshare information.

**traveler\_route**

This data item describes all the details of a specific traveler's route. This data item includes the information required to provide an initial route or a route change while enroute.

**traveler\_route\_accepted**

This data item contains the acceptance by the traveler of the previously provided route for on-line infrastructure based guidance. Acceptance must be provided before guidance can begin.

**traveler\_route\_constraints**

This data item is used to provide details of the constraints for a traveler route being requested.

**traveler\_route\_list**

This data item describes a specific traveler's route and includes all information intended for en-route traveler guidance.

**traveler\_route\_preferences**

This data item is used to provide details of the preferences for a traveler route being requested.

**traveler\_route\_request**

This data item contains data from which the route requested by a traveler can be determined, or that the previously provided data has been accepted.

**traveler\_total\_trip\_cost**

This data item contains the total cost of a traveler's trip. This will be a trip that has been previously confirmed by the traveler from either a personal device or a kiosk, and for which where necessary, reservations have been made.

**traveler\_traffic\_preference\_setting**

This data item contains information about the travelers preferences for receipt of traffic data.

**traveler\_traffic\_profile**

This data item contains a traveler's personal profile for obtaining traffic information. This profile is submitted one time and then used to generate future personalized trip information. This profile supports a subscription type of information dissemination to the traveler.

**traveler\_transit\_preference\_setting**

This data item contains information about the travelers preferences for receipt of transit data.

**traveler\_transit\_profile**

This data item contains a traveler's personal profile for obtaining transit information. This profile is submitted one time and then used to generate future personalized trip information. This profile supports a subscription type of information dissemination to the traveler.

**trip\_request**

This data item is used as a means of specifying the parameters needed for a trip or route to be provided to a driver or traveler.

**vehicle\_guidance\_route**

This data item contains a subset of the data items included in the route data item to meet the requirements of in-vehicle infrastructure based guidance as opposed to the more general requirements for a route need as part of a trip planning activity. This data item includes the information required to provide an initial route or a route change while enroute.

**vehicle\_guidance\_route\_accepted**

This data item contains the acceptance by the driver of the previously provided route for on-line guidance. Acceptance must be provided before guidance can begin.

**vehicle\_identity**

This data item contains the identity of a vehicle.

**vehicle\_location\_for\_advisories**

This data item contains the vehicle's location as computed from data input to sensors controlled by the processes that determines vehicle location. This is a low precision data item that has sufficient accuracy for filtering traveler and driver in-vehicle advisory data to make it relevant to the current geographic area where the vehicle is located.

**vehicle\_location\_for\_dynamic\_guidance**

This data item contains the vehicle's location as computed from sensor data. This is a high precision data item that enables the location of the vehicle to be pin-pointed to a high degree of accuracy and is used for in-vehicle dynamic guidance purposes.

**vehicle\_occupancy**

This data item contains a count of the time for which a vehicle occupied the point in the surface street or highway at which a detector is located.

**vehicle\_route\_constraints**

This data item is used to provide details of the constraints for a vehicle route being requested.

**vehicle\_route\_preferences**

This data item is used to provide details of the preferences for a vehicle route being requested.

**vehicle\_route\_request**

This data item contains a request for on-line guidance of the vehicle. This will have been generated by the driver and will include the necessary source and destination data from which a route can be computed.

**vehicle\_speed**

This data item contains the speed of a vehicle which has been detected by a detector located on the highway, as the vehicle flowed over its sensor.

**yellow\_pages\_advisory\_data**

This data item provides yellow pages data to drivers and transit users in vehicles and/or confirmation of a previously requested reservation.

**yellow\_pages\_dining\_information**

This data item contains details of those restaurants, diners, etc. that meet the specified location (and other) criteria.

**yellow\_pages\_dining\_reservation**

This data item contains a request for the information and service providers to make a dining reservation at a restaurant, hotel, etc. The reservation will be based on the data already provided to the traveler through a previous request.

**yellow\_pages\_dining\_reservation\_confirmation**

This data item contains a dining reservation confirmation and includes a confirmation number.

**yellow\_pages\_food**

This data item contains details of restaurants, fast food outlets that meet the specified location (and other) criteria.

**yellow\_pages\_gas\_stations**

This data item contains details of gas stations that meet the specified location (and other) criteria. The data item will also define the facilities available at the gas station, e.g. toilets, shop, food, the type(s) of fuel supplied, etc.

**yellow\_pages\_general\_information**

This data item contains the following items the contents of which will be specific to the area covered by the function and which will include contact telephone numbers, etc.

**yellow\_pages\_history**

This data item contains details of any sites of historic interest, etc. in the area served by the function. It will define the type of site, e.g. Civil War battle site and the description will define the address of the site.

**yellow\_pages\_hospitals**

This data item contains details of location(s), available facilities and visiting hours of hospitals in the area served by the function.

**yellow\_pages\_local\_customs**

This data item contains details of local customs, etc. in the area served by the function. The description will define the customs themselves, e.g. the days on which shops close early, etc.

**yellow\_pages\_lodging**

This data item contains details of hotels, motels, etc. in the area served by the function. It will define the type of hotel and the description will define the hotel chain (if applicable) and the address.

**yellow\_pages\_lodging\_reservation**

This data item contains a request for the information and service providers to make a lodging reservation at a hotel or motel etc. from the information already provided to the traveler through a previous request.

**yellow\_pages\_lodging\_reservation\_confirmation**

This data item contains a lodging reservation confirmation and includes a confirmation number.

**yellow\_pages\_lodging\_reservations**

This data item contains details of those hotels, motels, with dates and prices of available rooms. It will define the type of hotel and identify the hotel chain (if applicable) and the address.

**yellow\_pages\_parking**

This data item contains details of parking lots, on-street parking arrangements, etc. in the area served by the function. It will define the type parking, e.g. privately managed lot, municipally owned lot, free parking, on-street parking, etc. and the address.

**yellow\_pages\_people**

This data item contains details of local officials in the area served by the function. It will specify the office and define the part(s) of the area served and the address of the person's office.

**yellow\_pages\_private\_vehicle\_parts\_shops**

This data item contains details of vehicle parts shops in the area served by the function. It will define the type of vehicle parts available, e.g. engines, brakes, tires, mufflers, etc. and define the repair shop chain (if applicable) and the address.

**yellow\_pages\_private\_vehicle\_repair\_shops**

This data item contains details of repair shops in the area served by the function. It will define the type of repair shop, the type(s) of repair facilities that are available, e.g. general servicing, engines, brakes, tires, mufflers, etc. and will identify the business name and address.

**yellow\_pages\_rest\_areas**

This data item contains details of rest areas adjacent to roads and highways in the area served by the function. It will define the facilities available at the rest area, e.g. toilets, food, etc. and the location.

**yellow\_pages\_service\_contact**

This data item define the telephone, fax or e-mail contact information for the yellow pages service that is being provided.

**yellow\_pages\_service\_cost**

This data item contains the cost of an associated yellow pages service which is currently available.

**yellow\_pages\_service\_date**

This data item contains the date on which an associated yellow pages service will be available.

**yellow\_pages\_service\_description**

This data item describes the yellow pages service that is being provided. This may be the name of a hotel, theater or concert hall, the address of a sports stadium, the address of a garage, etc.

**yellow\_pages\_service\_location**

This data item contains the geographic location at which an associated yellow pages service will be available.

**yellow\_pages\_service\_time**

This data item contains the time at which an associated yellow pages service will be available.

**yellow\_pages\_service\_type**

This data item defines the type of yellow pages service that is being provided.

**yellow\_pages\_special\_events**

This data item contains details of special events such as parades, fairs, exhibitions, conventions, etc. in the area served by the function. It will define the type of event and the description will define the organizer(s) and address at which the event will take place.

**yellow\_pages\_specific\_information**

This data item contains information which will be specific to the area covered by the function and which will include details of what facilities are currently available for purchase, etc.

**yellow\_pages\_ticket\_information**

This data item contains details of those activities, services etc. for which tickets are required in the area served by the function, with dates and prices. It will define the type of activity or service and the description will define the address.

**yellow\_pages\_ticket\_purchase**

This data item contains a request for the information and service providers to make a ticket purchase for a special event, theater, tourist attraction, etc. from the information already provided to the traveler through a previous request.

**yellow\_pages\_ticket\_purchase\_confirmation**

This data item contains a ticket purchase confirmation and includes a confirmation number.

**yellow\_pages\_tourist\_activities**

This data item contains details of tourist specific activities in the area served by the function. It will define the type of activity and define the address at which the activity will take place.

**yellow\_pages\_tourist\_services**

This data item contains details of travel agents in the area served by the function. It will define the service(s) provided by the agent and the agent's address and contact information.

**yellow\_pages\_transaction\_information**

This data item contains information which will be specific to the area covered by the function and which will include details of what facilities are currently available for purchase, etc.